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ENGINEERING AND EQUIPMENT

No. 60

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USSR REPORT

ENGINEERING AND EQUIPMENT

No. 60

This serial publication contains articles, abstracts of articles and news items from USSR scientific and technical journals on the specific subjects reflected in the table of contents.

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USSR   UDC 629.12.03-843.8."313"

THE DEVELOPMENT OF MARINE GAS TURBINE ENGINES

ROMANOV, V. I. and LISOV, V.T.

[Abstract] The expanded use of gas turbine power plants in marine service
depends on the elimination of such drawbacks as an insufficient service
life, comparatively expensive fuel, and higher specific fuel consumption
than that of internal combustion engines. The most important task at present
is the fitting of displacement transport vessels with gas turbine plants,
where such plants at power levels above 8,000 h.p. are best designed in a
configuration utilizing exhaust gas heat. The economy of such turbine
installations is 20% higher and the power 25% higher than a simple cycle
gas turbine. Waste heat utilization configurations can employ one or more
turbines; two such twin turbine plants have been manufactured for trials
in the "Kapitan Smirnov" class of vessels. The turbine plant delivered a
nominal, long term power on a test stand of 25,000 h.p., taking into account
steam takeoff for shipboard needs (2,250 kg/hr), and the specific fuel
consumption can be achieved by increasing the gas temperature ahead of the
turbine. Fuel consumption is plotted as a function of this temperature
and it is shown that at $5 = 950°$ C, the specific fuel consumption for optimal
plant parameters will not exceed 152 g/(h.p. · hr). Work is going ahead on
a number of problem areas which are yet to be resolved: fuel filtering,
preparation, protection of the flow portion of a turbine against the corrosive
action of a number of salts (vanadium, sodium, potassium), the removal of
deposits from this section, etc. Data is presented in tabular form for a
variety of power plant configurations both in the planning stage and for
operating plants with overall power levels as high as 120,000 h.p. and service
lives of 100,000 hours. Figures 5; references 2: 1 Russian; 1 Western.

[208-8225]

TORSIONAL OSCILLATIONS OF MARINE DIESEL POWER PLANT WHEN RUNNING IN REVERSE

SHILIKHIN, A.A. and KONKS, G.A.

[Abstract] A design calculation procedure is outlined for the determination
of the possible torsional vibration loads in the steady-state reverse mode,
particularly for diesel-transmission power plants. An equation for the pro-
peller characteristic in the reverse mode is given and used as the basis
for analyzing the variation in the mean effective pressure in a diesel-
transmission plant when running, shut down and when the load is dropped.
Steps to deal with each of these cases are discussed and specific illustra-
tive examples of the 8ChSPN 18/22, 6ChSTN 18/22 and 6 ChSP 18/22 diesel
plants are adduced. In analyzing the resonance oscillations, the actual
multiple mass torsional oscillating system is replaced by an approximate
equivalent two mass system for the "engine--shaft--screw" system. The stresses
due to torsional vibrations in a propeller shaft of a marine diesel plant
are plotted as a function of r.p.m. For the various diesel-transmission
plants considered, of both six and eight cylinder designs, the error in
determining the reverse travel resonances using the proposed procedure
did not exceed 2% as regards frequency and 5% as regards amplitude as compared
to exact calculation. This preliminary estimate procedure for the resonances
can prove to be useful in designing other types of diesel plants. If the per-
turbing moments when running reverse are higher than when running forward, this
preliminary estimate can be considered necessary since the lack of forbidden
operating ranges when running forward is no guarantee of torsional vibrational
safety in reverse. Figures 4; references: 6 Russian.

[208-8225]

USSR

THE ACQUISITION AND DISSEMINATION OF MATERIALS ON THE HISTORY OF SOVIET
SHIPBUILDING

Moscow SUDOSTOYENIYE in Russian No 4, Apr 79 p 59

MALYSHEV, H.K., Member of the Shipbuilding H tory Section of the Moscow
Oblast Board of Scientific and Technical Soc ety

[Abstract] Participants at a conference organized by the Moscow oblast
Scientific and Technical Society Governing Board which was devoted to the
history of the development of domest.'c shipbuilding during the 60 years
under Soviet leadership heard and discussed a report by veteran shipbuilder
A.S. Petrov, "At the Dawn of Soviet Shipbuilding." The chairman of the ship-
building history section, Yu.G. Derevyanko, talked about the activity of the
talented organizer and manager, the director of the Admiralty Plant in the
1930's N.G. Barabanov. A seminar was also held: "Practical Work in the
Gathering and Dissemination of Historical Materials Relating to the Development
of Soviet Shipbuilding." M.M. Dement'yev, chief of the shipbuilding history
section of the Central Scientific Research Institute imeni Academician A.N.
Krylov, talked about the state of the work being done by this institute to
disseminate the materials received from enterprises and dealt with procedures,
instruction and other questions in detail. The seminar participants recommended
a number of practical measures to improve the collection of materials relating
to the history of the shipbuilding sector.

[208-8225]

USSR   UDC 621.472:621.863

ENERGY BALANCE OF A SOLAR THERMOELECTRIC GENERATOR

BAUM, V. A., AGABAYEV, CH. and OVEZSAKHTOV, N., Physicotechnical Institute, Academy of Sciences TadzhSSR

[Abstract] Paper delivered at the All-Union Conference on Use of Solar Energy, Ashkhabad, 1977. Calculations and short-term experiments have shown that solar thermoelectric generators may be fairly efficient and inexpensive to operate if good designing is used for the concentrators and optical systems. A method is given in this paper for calculating the attainable efficiencies of solar thermoelectric power generators. The technique is based on a four-factor formula for total efficiency as the product of the optical, thermal, thermocouple and commutator components of efficiency. It is shown that it should be possible in principle to make solar thermoelectric generators with efficiency approaching 75% of the efficiency of the thermocouple. Therefore efforts of researchers should be directed toward finding efficient semiconductor materials. To make the solar thermoelectric power unit practicable, materials with high mechanical properties are needed, and methods must be developed for cooling the battery and compensating for thermal stresses that arise in the battery. References 3: 1 Russian, 2 Western.

[279-6610]

USSR   UDC 621.833.51:621.472:546.28

MULTISECTIONAL SILICON PHOTOVOLTAIC CELLS FOR STUDYING THE OPTICAL AND ENERGY CHARACTERISTICS OF CONCENTRATORS OF SOLAR AND RADIANT ENERGY

GLIBERMAN, A. YA., KOVALEV, I. I., KRASILOVSKIY, V. I. and MEDVEDEVA, L. M., All-Union "Order of the Red Banner of Labor" Scientific Research Institute of Sources of Current

[Abstract] An examination is made of multisectional silicon photovoltaic cells in the form of p-n mesa structures made on a common single-crystal backing of n-type silicon. The cells are mounted on a glass-textolite printed circuit bc rd. The assembled unit is enclosed in a housing with a

multiple-pin plug for connecting wires from each section of the cell and with a transparent glass shield. The matrix geometry can be altered by connecting and disconnecting various photosensitive sections of the cell. It is shown that these structures can be used as receivers in studying the geometry of the mirror surface of solar concentrators, and also the distribution of radiant flux density in the focal spot, using a laser as the light source. Figures 3, references 5 Russian.

[279-6610]

OPTICAL METHODS OF CHECKING THE PARAMETERS OF THE DOPED LAYER OF SEMICONDUCTOR PHOTOVOLTAIC CELLS

GOLOVNER, T. M., ZHIDKOVA, YE. V. and PENKINA, N. V., All-Union "Order of the Red Banner of Labor" Scientific Research Institute of Sources of Current

[Abstract] The paper gives high-speed optical inspection methods developed by the authors for nondestructive precision determination of the depth of the p-n junction, surface concentration and gradient of concentration of dopant, and also the nature of distribution of current carriers in the doped layer of semiconductor photovoltaic cells: a method of determining the depth of the p-n junction from photosensitivity in the shortwave region of the spectrum, and a noncontact method of determining the profile of distribution of free carriers in thin unevenly doped layers from the spectral behavior of reflectivity in the region of absorption of light on the free carriers. The method for determining the depth of the p-n junction is applicable to depths greater than 0.5 μm. Accuracy is at least 15% and improves with increasing depth. The technique for determining the profile of the layer is applicable to layers in a thickness range of from 0.3 to about 1.3 μm and surface concentration of free carriers of $(1-5) \cdot 10^{20}$ with accuracy of about 30%. The method is not adequately sensitive for p-n junctions shallower than 0.3 μm. Figures 3, references 4: 3 Russian, 1 Western.

[279-6610]

USSR   UDC 621.383.44

THIN-FILM AND CERAMIC SOLAR CELLS BASED ON CADMIUM SULFIDE AND CADMIUM
SELENIDE

KOMASHCHENKO, V. N., MARCHENKO, A. I. and GEDORUS, G. A., Institute of
Semiconductors, Academy of Sciences UkrSSR

[Abstract] The authors discuss the results of development of heterojunctions
of two types based on polycyrstalline films of CdSe (thin-film type) and
pressed sintered tablets of CdSe and CdS (ceramic type) from the standpoint
of using them as solar energy converters and as other photoelectric devices.
The work was done at the Institute of Semiconductors of the Ukrainian Academy
of Sciences from 1965 through 1977. The thin-film heterojunctions were made
by thermal vacuum distillation of Cu_2Se onto the surface of polycrystalline
CdSE films about 5-8 μm thick. The CdSe films were pretreated by low-tempera-
ture heating in vacuum followed by selenium doping. In the ceramic solar
cells, the heterojunctions were made by treating the tablets in a heated
solution of univalent copper salt. The energy band structures of the hetero-
junctions are determined from analysis of capacitance-voltage, current-
voltage and photoelectric characteristics. The energy band diagram in the
Anderson approximation is given for the thin-film heterojunction in equilibrium
at 300 K. It is shown that current transmission in these cells is by a tunnel
mechanism. Figures 6, references 12: 9 Russian, 1 Hungarian, 2 Western.

[279-6610]

PRINCIPLES OF CALCULATING THE HELIOSTATIC FIELDS OF A SOLAR POWER STATION

ZAKHIDOV, R. A., Central Design, Planning and Technological Office of Scientific Instrument Making, Academy of Sciences UzSSR

[Abstract] The paper gives the basic principles of a computational model developed for a solar power plant of tower type with consideration of all major practical factors: characteristics of the source of radiation (the sun), relative location of heliostats, shape and accuracy of the reflecting surface, configuration of the radiation-sensing surface of the receiver and so forth. A formula is derived for calculating the distribution of irradiance on a predetermined receiver at any instant with consideration of all factors. The given relations can be applied to any specific solar power plant design. The model also gives direct data on energy losses due to screening and shading, enabling optimization of the arrangement and overall dimensions of the concentrating system of the solar power plant. Figure 1, references 14: 13 Russian, 1 Western.

[279-6610]

HEATING CHARACTERISTICS OF A CONCENTRATOR-RECEIVER SYSTEM WHEN A SURFACE WITH SELECTIVE ABSORPTIVITY IS USED

KUDRIN, O. I. and ABDURAKHMANOV, A., Moscow

[Abstract] An analysis is made of the possibilities for using the effect of selective absorption and emission at high temperatures in solar power plants. The heating characteristics of the system comprised of the concentrator and selective receiver are considered as an interrelated complex of efficiency and temperature parameters. Expressions are found for determining the distribution of threshold wavelength over the surface of the receiver as a function of the density of the incident radiation flux. It is shown that a receiver with spectrally selective absorptivity can be effective in a design with an

inexact concentrator of light construction. The effect will remain considerable even if some constant wavelength equal to the threshold value averaged over the entire receiver is used. Figures 5, references 5: 4 Russian, 1 Western.

[279-6610]

INVESTIGATION OF A SOLAR-POWER HEAT EXCHANGER

BAYMATOV, T., BAZIYEV, U. KH. and ABIDOV, T. Z., Physicotechnical Institute imeni S. V. Starodubtsev, Academy of Sciences UzSSR

[Abstract] The paper gives the results of an experimental study of solar-power heat exchangers in four versions: 1. without selective covering at normal air pressure between the receiver and transparent shield (ϵ_r = 0.9, ϵ_s = 0.9); 2. without selective covering and with vacuum heat insulation (ϵ_r = 0.9, ϵ_s = 0.9, $P < 5 \cdot 10^{-4}$ mm Hg); 3. with selective covering at normal pressure (ϵ_r = 0.1, ϵ_s = 0.9); 4. with selective covering and vacuum heat insulation (ϵ_r = 0.1, ϵ_s = 0.9, $P < 5 \cdot 10^{-4}$ mm Hg). In the versions with selective coverings, four glass tubes were placed in a vacuum chamber with application of multiple-layer selective coatings of the $Cu + Ni + SiO_2 + Ni + SiO_2$ or $Cu + Ni + ZnS$ type by thermal sputtering. After application of the selective covering, the cylindrical glass receiver was sealed to the outer glass shield, and the space between them was evacuated. Experiments done on these solar-power heat exchangers in 1973-1977 showed that the fourth version can be used to make solar collectors that operate at temperatures of up to 150°C with direct solar radiation. The use of additional heat insulation improves the efficiency of the heat exchanger by 10-15%. The third and fourth versions should be used with parabolic cylinder concentrators at receiver temperatures up to 300°C with selective coatings of the $Cu + Ni + SiO_2 + Ni + SiO_2$ type or the $Cu + Ni + ZnS$ type, and at higher temperatures, high-temperature selective coatings must be used. Figures 3, references 4 Russian.

[279-6610]

USSR   UDC 621.472

A TWO-MIRROR FACILITY WITH FLAT AND HYPERBOLIC SUBREFLECTORS

ALIMOV, A. K. and ALAVUTDINOV, D. N., Physicotechnical Institute imeni S. V. Starodubtsev, Academy of Sciences UzSSR

[Abstract] Paper delivered at the All-Union Conference on Use of Solar Energy, Ashkhabad, 1977. A two-mirror direct-tracking unit is proposed with flat and hyperbolic subreflectors and a main dish 20 m in diameter. The subreflector is fastened securely to the main dish at a distrance of 1.9 m from the focus. The thermal power of the system is 155.5 kW for radiation of 800 W/m^2. The angle of turn of the concentrator is 0-85° along the vertical, and a full circle in the horizontal plane. Figures 2, references 2 Russian.

[279-6610]

USSR   UDC 662.997:537.22

COMPARATIVE STUDY OF THE HEAT ENGINEERING CHARACTERISTICS OF THE HEAT RECEIVERS OF SOLAR BLAST HEATERS

KHATAMOV, S. O., Physicotechnical Institute imeni S. V. Stardubtsev

[Abstract] Experiments were done to determine the coefficients of convective heat exchange of heat receivers in solar blast heaters as a function of the flow of collant, and to compare the efficiency of different designs under the same external conditions. The results of the experiments are generalized as dimensionless equations. Analysis shows that the efficiency of solar blast heating facilities is considerably dependent on the temperature difference between the surface of the heat receiver and the ambient medium. Figures 3, references 2 Russian.

[279-6610]

USSR   UDC: 621.438.002.2:621.74.045

SPECIFICS OF THE TECHNOLOGY OF MANUFACTURE OF CENTRIPETAL TURBINES

GOLDUN, L. P. and POLYAKOV, A. A.

[Abstract] The task of this study was to develop the simplest possible technology of manufacture of models of the runners for centripetal turbines to be used for laboratory studies. The molds for casting of the models of the load-bearing and carrier disks of the runner are made by machining. A low-melting alloy is then used to make the models. These models are then placed in a box, and the space between them filled with an epoxy-based resin, to make a model of the flow-carrying passage through the turbine. This epoxy model can then be machined to produce a model for casting of vanes for the runner. Figures 4.

[264-6508]

USSR   UDC: 621-503

SELF-COMPENSATION OF CROSS KINEMATIC COUPLINGS IN THE DRIVE SYSTEMS OF ROBOT MANIPULATORS

GEISHERIK, V. S., Moscow

[Abstract] A study is made of the effect of self-compensation of cross kinematic couplings in the drive systems of robot manipulators, allowing a significant decrease in the kinematic mutual influence of movements. Internal transfer matrices are suggested for description of the complex structure of the kinematic drives of an arm, allowing effective synthesis of the system. The conditions of self-compensations and its maximum capabilities are determined. It is shown that the selection of internal transfer ratio on the basis of the conditions produced should be a component part of the procedure of design of the interconnected drive systems of robot manipulators. The minimum number of external compensating couplings is thus achieved, and their structure is greatly simplified. Figures 3, References 9 Russian.

[265-6508]

PROBLEMS OF SELECTION OF SYSTEMS OF COMPUTER EQUIPMENT BASED ON COMBINED SM
COMPUTER MODULES

FILINOV, YE. N., KABALEVSKIY, A. N., candidates of technical sciences,
ANTONOV, V. A. and OSTROVSKIY M. A., engineers

[Abstract] A discussion is presented of the problem of selecting the
components for computer systems, based on the experience gained in developing
the SM-3 and SM-4 control computer systems. The functional principles of
planning of systems, which must be made up of standard modules and at the
same time must satisfy the diverse needs of various users are discussed, and
a classification of the components to be used in combined systems is suggested
as a first stage in solving the problem of automation of planning of modular
computer systems. The question of documentation of computer systems is also
briefly discussed. As the range of use of computer equipment expands and
increasing numbers of decreasingly sophisticated users place increasing
demands on the hardware manufacturer in terms of the capability and ease of
use of computer equipment, manufacturers must become increasingly concerned
with problems such as convenience and ease of operation of customized systems
made up of standard elements, and the production of readable, informative
documentation. Figures 2.

[263-6508]

THE STRUCTURAL AND FUNCTIONAL CAPABILITIES OF PROBLEM-ORIENTED ANALOG-DIGITAL
THIRD-GENERATION COMPUTER SYSTEMS

USHAKOV, V. B., doctor of technical sciences, deputy director, Scientific
Research Institute of Computation Machinery, VITENBERG, I. M., doctor of
technical sciences, and PETROV, C. M.

[Abstract] A certain class of problems, such as the study of the complex
control systems of flight vehicles, can best be solved by a hybrid computer
system consisting of an analog processor plus a digital processor, operating
through a highly organized software system. Problem-oriented analog-digital
computer systems of this type may be of several types: 1) the analog-digital
processor for modeling of actual objects, which contains a digital processor
coupled to an analog processor; 2) a digital control system for an analog
object of control, including digital control computer and the digital-analog
interface; and 3) an analog-digital processor for modeling or control of objects
in which modern analog computer equipment is used to create a total of three
main compatible parts: the digital processor, digital-analog interface and
analog processor, allowing the end user to select the configuration for his
particular problem. This article describes the ATSVK-3 hybrid computer system
developed at the Scientific Research Institute of Computation Machinery and
including a type YES-1010 digital computer and one to three type AVK-32
analog computers. Photographs of the two computers and the interface equipment
are presented, as well as a block diagram of the structure of the software
system. Examples of successful application of hybrid computer systems in the
West are cited. Figures 9, References 3 Russian.

[263-6508]

USSR   UDC: 629.7.036.34

THE GAS SCREEN IN GAS TURBINE ENGINES

VARGANOV, I. S.

[Abstract] A study is made of gas screens as applicable to a turbo-fan engine in the secondary loop. As it operates, gas is taken off after the turbine at a certain angle to the flow of air in the secondary loop, thus creating a gas screen for thrust reversal. A mathematical study is presented of the conditions under which thrust reversal is complete for the secondary loop. Figures 3, References 13 Russian.

[264-6508]

USSR   UDC: 621.438.001.24

DIGITAL COMPUTER CALCULATION OF STEADY TEMPERATURE FIELDS IN THE DRIVE VANES OF AIR-COOLED TURBINES

LOKAY, V. I., IVAN'SHIN, YU. N. and ABDRAKHMANOV, SH. SH.

[Abstract] A simple engineering method is presented for digital computer calculation of the steady temperature fields in the blades of turbines with longitudinal cooling of panels with variable boundary conditions, considering changes in the cross-sectional area of a vane and the variation of the coefficient of heat conductivity of the material of the vane as a function of temperature. The method is based on subdivision of the blade into sections, within each of which the problem of heat conductivity is solved as a one-dimensional problem (along the radius), after which the solutions are mated at the places where the areas join. Calculated and experimental values of temperatures at various points on a vane are presented. Figures 3, References 6: 4 Russian, 2 Western.

[264-6508]

SELECTION OF OPTIMAL PARAMETERS FOR A HEAT EXCHANGER WITH HEAT PIPES, TO BE
USED FOR A GAS TURBINE ENGINE

LOKAY, N. V. and MOSIN, I. I.

[Abstract] Certain requirements are presented, facilitating achievement of the
maximum degree of regeneration in a gas turbine engine. It is shown that in
a specific engine equipped with a heat exchanger, the degree of regeneration
can be increased by observing a number of conditions. The conditions are:
the heat-transmitting capacity of the heat pipes must be greater than the rate
of heat delivery to the heat exchanger, which means that different liquid-metal
coolants will have to be used along the path of the cooling exhaust gases;
and $\alpha F/Gc_p$ must be equal on the gas and air sides of the heat exchanger.
Figures 3, References 5: 4 Russian, 1 Western.

[264-6508]

METHOD OF CALCULATION OF THE OPTIMAL PARAMETERS OF HIGH PRESSURE PNEUMATIC
DRIVES

PANOV, M. YA., KURGANOV, A. M. and KOZELKOV, V. P.

[Abstract] A study is made of the optimization of the high pressure air
startup system used to start a turbine engine spinning and accelerate it to the
speed at which the process of combustion in the engine can take over its
operation. An experimental installation in which the energy was consumed by
two centrifugal pumps was studied, and the results produced by mathematical
analysis and direct experimentation compared. Figures 4, References 3 Russian.

[264-6508]

THE INFLUENCE OF SHORTENED SHROUDS ON THE OPERATION OF A TURBINE STAGE

KUZ'MICHEV, R. V. and PROSKURYAKOV, G. V.

[Abstract] Studies of two rotating models of turbine stages were performed
in the turbine laboratory of the Bryansk Institute of Transport Machine
Building. The models used vanes with unilateral or bilateral shrouds at their
ends. During the studies, the angles of the flow around the vanes were measured
with an accuracy of 1°, and the full and static pressures were measured with
an accuracy of 1 or 2 Pa. The experiments showed that the shroud had no sig-
nificant positive effect over a significant range of operating conditions.
Thus, the use of shortened single or double-sided shrouds in operating turbines
was found to complicate their manufacture significantly, while insignificant-
ly improving the structure of the flow around the periphery of the stage,
yielding no noticeable increase in efficiency within the ranges of dimensions
and operating parameters ordinarily used. Figures 2, References 6 Russian.

[264-6508]

TWISTING OF THE DRIVE BLADES OF AN AXIAL TURBINE STAGE WITH TANGENTIAL IN-
CLINATION OF THE GUIDE VANES

MUMYUSHKIN, YU. I., PEREVOZNIKOV, A. V. and YAKOVLEV, V. P.

[Abstract] Tangential inclination of the guide vanes in an axial turbine,
an effective means of decreasing the gradient of reaction over the length of
the drive vane, significantly redistributes the parameters of the flow over
the height of the flow-carrying section and places certain conditions on the
necessary twisting of the drive vanes. Studies of nine turbine stages were
performed at exit speeds of $M = 0.48-0.5$ and Reynolds numbers of $5-5.7 \cdot 10^5$ at
the exit cross sections of the nozzles. It was found to be desirable to twist
the output edges of the drive vanes to assure constant operating conditions,
though drive vanes with untwisted exit edges can be used. Figures 2. References
5 Russian.

[264-6508]

CONTROL WITH AN EXTRA NUMBER OF GYROS

SOROKIN, A.V., Leningrad

[Abstract] The orientation of a solid object rotating about a stationary point 0 is controlled by a servomechanism which includes a computer and a set of power gyros. The computer processes deviations from the prescribed parameters of motion of the object and generates appropriate control signals, in response to which the gyros produce corrective torques. The angular momentum of each gyro is oriented in the direction of its rotor axis and the resultant angular momentum of the system is equal to the sum of the angular momenta of all the power gyros in it. The necessary control action is produced by controlling the orientation of the angular momenta of the power gyros relative to the object, a change of this orientation being achieved by means of special devices which turn the gyros. With the motion of the object described by vector equations in two Cartesian systems of coordinates with a common origin at 0, one a stationary inertial system and one system rigidly tied to the object, the control algorithm for the gyros controlling the motion of the object relative to the stationary inertial system of coordinates is constructed in a form suitable for control optimization by the gradient method and for computer processing of input data by numerical integration of the system of differential equations to which the vector equations of motion have been reduced. References: 3 Russian.

[278-2415]

STABILITY OF MOTION OF A GYRO IN A CONTACTLESS SUSPENSION DURING ANGULAR
OSCILLATIONS OF THE BASE

SAVCHENKO, T.A., Vladimir

[Abstract] A gyro in a contactless suspension is considered with a base
harmonically oscillating about some axis whose orientation in space remains
invariant. The center of mass of the gyro rotor coincides with the geometric
center of its spherical surface so that translations of such a rotor are
mutually independent. A real suspension is not conservative, unlike an ideal
one, so that angular oscillations of the base influence the motion of the
center of mass of the gyro rotor and can make this motion unstable. Here this
problem is analyzed on the basis of the equation of motion in a trihedral
system of vectors, this equation being transformed to a system of differential
equations with small perturbations. The latter equations are then reduced to
a single equation, after an appropriate change of variables, whereupon the
particular solution is sought in the series form with the aid of the Hill
determinant. The resulting system of two parameteric equations is averaged
so as to simply yield the ranges of unstable and asymptotically stable motion,
in the trivial case of zero characteristic frequency as well of the two
resonance conditions with the characteristic frequency equal to or double the
oscillation frequency. References: 6 Russian.

[278-2415]

NONCONSERVATIVE TORQUES AND THEIR EFFECT ON THE PRECESSION OF A CONTACTLESS
GYRO

DENISOV, G.G. and KOMAROV, V.N., Gorkiy

[Abstract] A tracking gyro with a contactless axisymmetric suspension of the
rotor is considered, drift torques being minimized by alignment of the gimbal
axis of symmetry with the angular momentum of the rotor. The trajectories
of such a gyro are calculated from the equation of motion in a system of
coordinates stationary with respect to the earth. In the case of nonconserva-
tive torques produced by tangential forces, due to dry or viscous friction
or due to rotor unbalance or asphericity, the density of normal forces acting
on the gyro is assumed to be constant at any point on the surface. The re-
sulting precession is analyzed separately for large and small torques (relative
to the torque due to the earth's rotation), the form of the equation of motion
being different in each case because of the different relations between
characteristic parameters. The number of equilibrium states and the number
of cycles depends on the kind of nonlinearity assumed for the dissipative
torque. Figures 5; references: 13 Russian.

[278-2415]

A PNEUMATIC DISTRIBUTOR FOR A TURBOJET ENGINE CONTROL SYSTEM

KHABIBULLIN, M. G.

[Abstract] A pneumatic distributor device has been developed for use in the
thrust reversal system of the NK-8-2U turbojet engine on the Tu-154 aircraft.
The distributor is diagrammed and briefly described. As of the beginning of
1977, the distributor had operated for a total of 100,000 failure-free hours.
Figure 1, References 2 Russian.

[264-6508]

PHOTOACOUSTICAL SPECTROSCOPY OF SOLIDS

LYAMOV, V. YE., MADVALIYEV, U. and SHIKHLINSKAYA, R. E., Moscow State
University imeni M. V. Lomonosov, P-ysics Department, Acoustics Section

[Abstract] The recently developed method of photoacoustical spectroscopy
is free of many of the shortcomings of ordinary optical spectroscopy, which
cannot be used to study powders, resins or living tissues. In photoacoustic
spectroscopy, modulated light, absorbed by the specimen is converted to an
acoustical wave, which is received by a microphone. The specimen to be studied
is placed in a sealed cavity filled with a gas; one wall of the cavity is the
diaphragm of a sensitive microphone. The specimen is illuminated with modulated
monochromatic light. A block diagram of a photoacoustic spectrometer is
presented. The method is quite effective for study of the optical character-
istics of strongly absorbing media. It can be used for quantitative determina-
tion of the optical and thermal characteristics of speciments and to study the
spectra of sources or radiation. Its applications lie not only in the area
of physical studies, but also chemical and biological research. Figures 8,
References 18: 5 Russian, 13 Western.

[260-6508]

A METHOD OF HOLOGRAM FORMATION

ANDRENKO, S.D. and SHESTOPALOV, V.L., Institute of Radiophysics and
Electronics, Academy of Sciences of the Ukrainian SSR, Kharkov

[Abstract] All known methods of hologram formation are based on interference
of two space (plane or spherical) waves. Here the interference of a space
wave (object) and a surface wave (reference) is considered. A simple analysis
indicates that, with a fixed holographing angle, the hologram period can be
regulated over a wide range by varying the decrease in the phase velocity of

the reference wave through the waveguide. This principle is applied in properly positioning the photosensitive film relative to the waveguide. An advantage of using one surface wave instead of another space wave is that reconstruction of the hologram by a plane wave with the relative phase velocity v_ϕ/c (c denoting the velocity of light in free space) equal to the relative hologram period $1/\lambda$ (λ denoting the wavelength) and transformation of surface waves to space waves produces only one image rather than three or two. This is possible at interference angles also larger than 90° up to 180° for hologram recording, if the reference wave is sufficiently retarded and the hologram period is correspondingly small. Figures 2; references 7: 5 Russian, 2 Western.

[259-2415]

USSR

UDC 621.373.8

A TUNABLE PERIODIC-PULSE LASER ON A CRYSTAL OF LITHIUM FLUORINE WITH F_2^+ CENTERS EXCITED BY SECOND-HARMONIC EMISSION FROM A GARNET LAZER WITH Nc^{3+} -CENTERS

BASIYEV, T.T., MIROV, S.B., and PROKHOROV, A.M., academician, Institute of Physics imeni P. N. Lebedev, USSR Academy of Sciences, Moscow

[Abstract] A tunable periodic-pulse laser has been experimentally produced on a LiF crystal with F_2^+-centers. In both the wideband version (0.80-1.1 um) and the narrow-band version (0.87-0.99 μm) the LiF (F_2^+) cyrstal is placed inside a plane-parallel Fabry-Perot resonator, with precisely longitudinal pumping by second-harmonic emission from an LTIPCh-7 garnet laser with Nd^{3+} -CENTERS (λ = 0.532 μm). Both can generate pulses of 6.10^{-9}s durations and 4.7 kW power, at repetition rates as high as 50 Hz without forced cooling and with a beam divergence not exceeding 10^{-3} rad. The conversion efficiency is 4.7%, i.e., four times higher than with pumping from a o-switched mono-pulse ruby laser. The authors thank V.M. Khulugur for supplying the LiF crystal with oxygen-stabilized F_2^+-centers. Figures 2; references 15: 7 Russian, 1 German, 7 Western.

[259-2415]

ON THE SHAPE OF DEFLECTION OF THE SURFACES OF A CIRCULAR MEMBRANE PRODUCED
BY ELECTROSTATIC ATTRACTION

KAMIL'DZHANOV, A. KH., Tashkent "Order of the Red Banner of Labor" Institute
of Railroad Transportation Engineers

[Abstract] The author considers the problem of electrostatic sagging of two
axisymmetric homogeneous films of circular outline securely fastened around
the edges, of identical dimensions and parallel. It is assumed that the films
are covered with a thin layer of aluminum on one side. Charging these membranes
causes Coulomb attraction that produces a certain shape of the surface. An
examination is made of the feasibility of using such surfaces as reflectors.
It is shown that the reflector becomes long-focus as sagging in the center
increases with increasing $\lambda = 2 \xi l /T$, where ξ is the coefficient of charge
distribution, $2l$ is the distance between the planes of the membranes, and
T is the stresses developed in the membrane. Figures 2.

[279-6610]

EFFECT OF SPATIAL INHOMOGENEITIES IN THE AIR CHANNEL ON THE ACCURACY OF
OPTOELECTRONIC INSTRUMENTS FOR 3-POINT CHECKING OF RECTILINEARITY

GRIDIN, A.S. and TIMOFEYEV, A.N., Chair of Optoelectronic Instruments,
Leningrad Institute of Precision Mechanics and Optics

[Abstract] Fluctuations of the refractive index due to inhomogeneities in
air cause random transverse shifts of the optical equisignal zone for opto-
electronic instruments used in 3-point checking of rectilinearity. Here
the dependence of such transverse shifts on the geometrical relations between
the scale of inhomogeneities, the dimensions of both instrument irises and the
distance from the illuminator iris to the receiver iris is examined analytically.
The air channel is assumed to be isotropic with a uniform distribution of
inhomogeneities, their scale equal to the correlation radius of fluctuations

and much larger than the maximum wavelength of the light used for measurements.
The calculations yield the error due to this instability of the measuring base,
and the results indicate how the instrument irises can be designed to minimize
the rms shift of the optical equisignal zone. Figures 2; references 7: 6
Russian, 1 Western.

[276-2415]

CORRECTION OF ASTIGMATISM IN LARGE-APERTURE SYSTEMS

ANITROPOVA, I.L. and VELIKOTNYY, M.A., Chair of Theory of Optical Instruments,
Leningrad Institute of Precision Mechanics and Optics

[Abstract] Large-aperture objectives with wide angles of vision are considered
where the front iris has been moved forward and the resulting astigmatism
cannot be eliminated. Instead, a surface for correcting this astigmatism is
calculated, with the aid of sagittal and meridional invariants. This surface
is found to be concentric with the objective focus. It can be a meniscus
with the proper radius and thickness, also properly positioned relative to the
power lens of the objective. Figures 2; references: 3 Russian.

[276-2415]

OPTIMIZING THE WIDTH OF THE RADIATION PATTERN OF THE TRANSMITTER IN AN OPTO-
ELECTRONIC SCANNING INSTRUMENT

ARZHANIKOV, YU.N. and YEGOROV, V.I., Chair of Optoelectronic Instruments,
Leningrad Institute of Precision Mechanics and Optics

[Abstract] The detectability of stationary objects by optoelectronic scanning
instruments with active components is analysed, particularly the effect of the
transmitter radiation pattern on this detectability. The efficiency criterion
for the search process is the width of the transmitter radiation pattern which
requires the minimum transmitter radiation power to attain a given detection
probability. The analysis is carried out for a "point" object and for an ex-
tended rectangular object, both regarded as isotropic plane reflectors. The
transmitter is assumed to operate without additional transverse modes, the
distribution of the illumination intensity over the plane of the object being
a Gaussian one, and the photoreceiver being inertialess. The expression
derived for the output pulse signal includes the Kramp error function and
indicates that only the amplitude and the time delay but not the shape of this
pulse depend on the position of the object within the search field. Numerical
calculations reveal, furthermore, that there is an optimum width of the trans-
mitter radiation pattern and that this optimum width increases for lower de-
tection probabilities but does not depend much on the false-alarm probability.
Figures 4; references: 6 Russian.

[276-2415]

MODERNIZATION OF THE 120-CENTIMETER CYCLOTRON

SARKISYAN, L.A., KIR'YANOV, YE. F. and VOROB'EV, YU. A.

[Abstract] In late 1977, the classical 120-cm cyclotron at the Scientific
Research Institute of Nuclear Physics, Moscow State University, was modernized,
increasing and allowing smooth regulation of the energy of ions and expanding
the assortment of ions which could be accelerated. This was achieved by re-
shaping the decrease in the magnetic field as a function of radius and by
adjusting the resonant frequency. In order to minimize the design changes,
cost and shutdown time required for modernization, it was decided to shape the
magnetic field using the same windings, installed within the vacuum chamber
on its cover, over a -road range of levels of magnetic field intensity at the
center. Experimental curves are presented of the variation of magnetic
field as a function of radius at twelve levels of center field intensity,
from t to 16 kOe. The modernized cyclotron now achieves the highest energy
of deuterons and alpha particles of any 120-cm cyclotron in the USSR. The
cyclotron was returned to operation in January of 1978. Figures 3, References
3 Russian.

[277-6508]

DESIGN OF A CHANNEL FOR ELECTRON COOLING OF A PROTON BEAM FOR INJECTION
INTO A LINEAR ACCELERATOR

BATALIN, V. A.

[Abstract] An estimate is produced of the possibility of decreasing
emittance of a proton beam by one-time passage of the beam through an electron
cooling channel, in order to increase the intensity at the output of a linear
accelerator into which the beam is injected. Pierce optics are used to
produce the intensive beam of slow electrons with slight variations in trans-
verse velocities needed. A diagram is presented of the system used for input
of the tubular beam of protons into the cooling channel, as well as the
system which forms the electron beam. The electron cooling system suggested
has not yet been actually constructed. Figures 3, References 11: 9 Russian,
2 Western.

[277-6508]

A RESONATOR SENSOR OF CHARGED PARTICLE BEAM PARAMETERS

VOYEVODIN, M. A., KOVALENKO, A. D., PAVLOV, P. P. (deceased) and POPOV, V. A.,
Joint Institute of Nuclear Research, Dubna

[Abstract] The devices used to measure the parameters of beams of charged
particles are usually cylindrical cavity resonators. The resonators which
must be used on linear heavy charged particle accelerators must either be
quite long (over 1 meter) or must operate on high harmonics of the accelerating
field, reducing sensitivity and accuracy. This article suggests another
possibility for decreasing the dimensions of the sensors, by the use of toroidal
resonators rather than cylindrical cavity resonators. A diagram and photo-
graph are presented of a toroidal resonator for use on the LU-20 linear
accelerator which is the particle injector of the Dubna synchrophasotron.
The resonator is separated by a vacuum from the volume through which the
beam of particles flows, significantly simplifying the design and technology
of manufacture of the transducer and facilitating adjustment of the resonant
frequency, as well as pickup of information. The resonator is sensitive not
only to changes in the beam current, but also to changes in the instantaneous
energy spectrum of the beam; therefore, the sensitivity depends on the phase
consistency of the beam. Figures 3, References 7: 3 Russian, 4 Western.

[277-6508]

USSR   UDC: 621.373.4:534-8

A PULSE GENERATOR TO SUPPLY ACOUSTO-OPTICAL SHUTTERS

PRISHUTOV, A.A. and TERENT'EV, V. YE.

[Abstract] A high frequency pulse generator designed for excitation of a
solid state Bragg diffraction modulator, with two counter-directed
traveling ultrasonic waves, is described. A schematic diagram of the
generator is presented. The device utilizes 14 vacuum tubes and operates
in three modes: 1) excitation of 2 millisecond groups of traveling un-
modulated ultrasonic waves, propagating to the acousto-optical shutter in
opposite directions and interrupting lasing; 2) formation of a single sequence
of ultrasonic oscillations in one side and several sequences in the other, at
an interval of 1 to 3 µs, resulting in the generation of short light pulses
by the laser at points of overlap of the ultrasonic wave trains; and 3)
modulation of the traveling ultrasonic wave by pulses supplied by an external
oscillator. Figures 2, References 4: 3 Russian, 1 Western.

[277-6508]

USSR   UDC: 621.378.33

A COMPACT ELECTRIC DISCHARGE CO_2 LASER WITH A RADIATED ENERGY OF 30 J

AFONIN, YU. V., PONOMARENKO, A. G., ORISHICH, A. M. and SHALAMOV, S. P.,
Institute of Theoretical and Applied Mechanics, Siberian Division, USSR
Academy of Sciences, Novosibirsk

[Abstract] A prototype of an electric discharge CO_2 laser is described and
diagrammed. The operating principle system is as follows: a capacitor is
charged by a high voltage rectifier. When a small discharge gap is bridged,
voltage is applied through a circuit including an inductance to the main
discharge gap and the preliminary ionization system. Breakdown of a variable
capacitor produces a charge on the dielectric surface of a long supplementary
electrode, a powerful source of ultraviolet radiation. Series connection of

two additional capacitors and an inductance allows additional overvoltage to be applied to the discharge gap, forming a uniform space discharge. The technical characteristics of the CO_2 laser system are: radiated wavelength 10.6 μm, maximum radiated energy in a single pulse 30 J; maximum radiated power 10^8 W, gas mixtures used $1CO_2$: $2N_2$: $0.5H_2$ at 0.25 atm, operating life about 10^4 pulses. Figures 4, References 8 Russian.

[277-6508]

KARARUZIKOV, A. I.

[Abstract] A CO_2 electric discharge laser is described in which excitation is achieved by the use of a circuit with pulse discharging of accumulating condensors, allowing overvoltages across the discharge gaps of 20 to 30% to be achieved, decreasing the uncertainty of discharge time to 1 ns. Lasing occurs at 10.6 μm with an energy of 2-3 J, and a relative variation of energy of +6% or less. The use of pulsed laser system power supplies thus increases the stability of pumping the reproducability of laser pulses, while simplifying the design of a number of elements of the system. A diagram is presented of the shape and mutual placement of the preionization, current and laser generation pulses. Figures 2, References 3 Russian.

[277-6508]

INTERMODE BEATING IN CO_2 LASERS AND ITS USE IN FREQUENCY SELF-TUNING SYSTEMS

BYKOV, P. A., GALUTIN, V. Z., YEPIFANOV, V. P., SVIRIDOV, A. N. and SHUMAKOV, V. R.

[Abstract] An experimental study was performed of the variation in beat frequency with changes in the basic parameters of a laser, including tuning of the resonator, current, discharge, and pressure of the lasing media, with fixed adjustment of the resonator, in order to allow the phenomenon to be used to stabilize the frequency of the radiation of the laser by comparison with the frequency of a reference RF oscillator. Measurement of the variation of optical beat frequency as a function of resonator tuning shows that the beat frequency changes linearly by about 200 KHz as the optical frequency changes by about 90 MHz. This allows a piezoelectric corrector to be used, with a sawtoothed voltage applied, generated as a function of the beat frequency. Figures 4, References 4 Russian.

[277-6508]

INFLUENCE OF ACOUSTICAL NOISE AND CURRENT FLUCTUATIONS ON THE WIDTH OF THE BEAT FREQUENCY LINE OF CO_2 LASERS

BYKOV, P. A., YEPIFANOV, V. P. and SVIRIDOV, A. N.

[Abstract] A study is made of the variation of line width of the beat frequency of CO_2 lasers as a function of pulsations in the power supply current and acoustical noise. Measurements were made on a laser isolated from vibration by installation on a massive plate. A speaker located near the mirror of one of the two lasers in the installation applied an acoustical signal at 20 to 10,000 Hz at 70-100 DB. Analysis of the results of measurements indicates that the line width of the frequency of the two lasers is influenced not only directly by pulsations of current and acoustical fluctuations, but also by fluctuations in pressure caused by pulsations in

the discharge current. A modernized version of the laser installation is
suggested to reduce the influence of fluctuating components at about 1,000
Hz on the beat frequency line width, in which the pressure fluctuations act
through a communicating channel on both halves of the displacement adjuster
to which the resonator mirror is attached, compensating each other. Figures
4, References 2: 1 Russian, 1 Western.

[277-6508]

A SIMPLE CARBON DIOXIDE GAS AMPLIFIER

ALOLLONOV, V. V., BARCHUKOV, A. I., DERZHAVIN, S. I., KONONOV, I. G., FIRSOV,
K. N., SHAKIR, YU. A. and YAMSHCHIKOV, V. A., Institute of Physics, USSR
Academy of Sciences, Moscow

[Abstract] An amplifier containing an ultraviolet preionization discharge
operating with a mixture of CO_2, N_2 and He, with the addition of tripopylamine
as an easily ionized impurity, is described. Doping with tripropylamine
allows a simple Lamberton-Pierson system to be used for preliminary ioniza-
tion of the gas-discharge gap. The amplifier is also easy to tune and reliable
in operation, and the gain achieved is comparable to the gain achieved by
CO_2 amplifiers with electron beams. A schematic diagram of the pumping system
of the CO_2 amplifier is presented, as well as oscillograms of voltages and
current in the discharge in a CO_2:N_2:He mixture of 1:2:3. Figures 3, References
5: 2 Russian, 3 Western.

[277-6508]

USSR   UDC: 621.373.027.7

SELECTION OF COEFFICIENTS OF REFLECTION OF THE MIRRORS OF A LASER RESONATOR
FOR INTRACAVITY MODULATION

VOROBEYCHIKOV, E. S., PIVOVAROV, B. L., POPOV, L. N. and POYZNER, B. N.,
Siberian Institute of Physics and Technology at Tomsk State University

[Abstract] An experimental study was conducted of the optimal reflection co-
efficients of the mirrors used in a laser resonator in the intracacity modula-
tion mode, and to determine the range of resonator reflection coefficients
within which stable lasing occurs. A KDP crystal was placed in the resonator
of an He-Ne laser so that the light did not change its polarization upon
passage through the crystal. The crystal was placed in the resonator at the
Brewster angle. During the experiments, a set of spherical mirrors with co-
efficient of reflection between 98.8 and 99.9%, and a set of flat mirrors
with coefficient of reflection between 97.5 and 99.9% were used, allowing the
total transmission of the mirrors to be varied from 0.2 to 3.7%. The optimal
coefficient of transmission was found to be about 1.5% when the KDP crystal
was used for frequency modulation. At over 1.7%, the position of the crystal
in the resonator becomes critical. Figures 2, References 4 Russian.

[277-6508]

USSR   UDC: 535.417:621.375.826

AN INTERFERENCE METHOD OF MEASUREMENT OF THE FOCAL LENGTHS OF HEAT LENSES
IN THE ACTIVE ELEMENTS OF SOLID-STATE LASERS

KOPYLOV, YU. L., Institute of Radio Equipment and Electronics, USSR
Academy of Sciences, Moscow

[Abstract] A method is described for interference measurement of the focal
length of heat lenses in solid-state lasers, utilizing a three-slit Zernike
interferometer, which is highly sensitive to path differences (10-30 A), due
to the appearance to additional path differences between the rays from the
outer and central slots. The method was used to measure the temperature

dependence of the focal length of heat lenses in active elements made of a number of commercial laser glasses. The graph is presented of the variation of effective aperture with temperature in a cylindrical element with a mean pumping power of 500 W. Figures 3, References 6: 5 Russian, 1 Western.

[277-6508]

A METAL CERAMIC DISCHARGE CHAMBER FOR A NITROGEN LASER WITH TRANSVERSE EXCITATION

PAPAKIN, V. F. and SONIN, A. YU., Rostov State University

[Abstract] Discharge chambers for a laser were made of an alundum ceramic, duralumin and plexiglass. The laser used in the experiments was powered by a Blumlein circuit. The mean lasing power was measured as a function of nitrogen pressure in the discharge chambers and capacitance in the arms of the power supply circuit. The greatest power was achieved by using a discharge chamber with ceramic walls with slots in them. This same design also produced lasing over the broadest range of gas pressures. Figures 2, References 2 Russian.

[277-6508]

EMERGENCY PROTECTION OF A UNIT OF A LASER FLASH PUMPING UNIT SUPPLIED BY AN INDUCTIVE ENERGY ACCUMULATOR

AZIZOV, E. A. and GENDEL', YU. G.

[Abstract] A system is described for emergency protection of a pulsed flash lamp unit supplied by an inductive energy accumulator, which operates by varying the voltage across the flash lamps as the current pulse passes through them. The range of permissible variation of voltage is established by measuring the voltage drop across the flash lamps as the energy from the inductive accumulator flows through them. A schematic diagram of the device is presented, as well as a diagram of the voltages across the flash lamps during operation. The operating speed of the emergency protection system is 2-3 μs. Figures 3, Reference 1 Western.

[277-6508]

EXCIATION OF EMISSION IN ORGANIC MOLECULES BY RADIATION FROM EXCIMER LASERS

KOPYLOVA, T.N., GRUZINSKIY, V.V., DANILOVA, V.I., TARASENKO, V.F., FEDOROV, A.I., DEGTYARENKO, K.M. and VERNIGOR, YE.M.

[Abstract] Lasers on excimer molecules AX* (noble gas halides), excited by an electron beam or an electric discharge, are used for pumping polyatomic molecules with pulses of short duration at various wavelengths within the ultraviolet range. Optimum thermal performance is achieved by optical pumping with the minimum difference of Stokes losses $\Delta_S = \mathcal{V}_{pump} - \mathcal{V}_{exit}$, and a difference as small as 60 cm^{-1} has been attained with a solution of rhodamine 6G by frequency tuning. Here a study was made to determine the optimum emission parameters of a transverse-discharge laser on an XeCl* excimer molecule, also the spectral and emission characteristics of polyphenols, aryloxazols and arylbenzoxazols in various solvents excited by such an excimer

laser (λ_{pump} = 308 nm with two lines 307.92 and 308.16 nm) and, for comparison, by a nitrogen laser (λ_{pump} = 337.1 nm). The optimum mixture for an excimer laser was found to be He:Xe:CHCl$_3$ = 1800:20:1. The authors measured the wavelengths of maximum-absorption bands, fluorescence and emission bands, the relative intensities of two bands corresponding to the vibrational maxima in fluorescence and emission spectra, also the threshold pumping power and the emission efficiency. Figures 4; references 25: 19 Russian, 6 Western.

[282-2415]

EFFECT OF SUPERLUMINESCENCE IN HIGH-GAIN ACTIVE MEDIA ON THE ENERGY
CHARACTERISTICS OF MONOPULSE LASERS

VASIL'YEV, I.V., ZVEREV, G.M., ZINOV (YEV, S.V., ONISHCHENKO, A.M. and
SEMENOV, A.A.

[Abstract] The monopulse emission energy generated in high-gain active media such as yttrium-aluminum garnet (or yttrium aluminate) + neodymium ceases to increase with higher pumping energy when superluminescence at the emission wavelength begins to limit the output. Here a simple inverse relation is established between the maximum area (cross section) density of energy storable in an active cell and the cross section for $^4F_{3/2}$ - $^4I_{9/2}$ transition. Parameters in this relation are the energy of a photon, the degree of inversion saturation, and the half-superluminescence angle. Experiments made with cylindrical specimens and subsequent approximate calculations on the basis of available data confirm the validity of this relation and thus also the effect which the finish of the lateral surface has on the cross section for laser transition. Figures 2; references 5: 3 Russian, 2 Western.

[282-2415]

SOME ANOMALIES OF EMISSION FROM A HELIUM-NEON LASER IN A HOLLOW COPPER
CATHODE AT A WAVELENGTH OF 632.8 nm

KARTALEVA, S.S., STEFANOV, V.Y. and DIMITROVA, D.S., Institute of Electronics,
Bulgarian Academy of Sciences, Sofia (Bulgaria)

[Abstract] Experiments were performed with helium-neon lasers in a hollow
copper cathode of rectangular cross section, resulting in emission at the
neon line (632.8 nm) with discharge modes and with gain characteristics
different than in earlier studies. Here the cathode was a copper cylinder
with a 2 mm wide and 6 mm deep slot, inside a ceramic insulator ring with a
matching slot, and the anode was a rod of stainless steel 7 mm away from the
cathode parallel to the slot. The resonator cavity was formed by two spherical
mirrors. The emission output power was found to peak over a rather wide range
of He+Ne mixture pressures, depending on the ratio of partial pressures. The
optimum mixture, unlike in earlier studies, was He:Ne = 25:1 with $P_{opt}.d$
(product of optimum mixture pressure and cathode diameter) $\approx$ 14 torr.mm.
Also the maximum gain was 6-7 %.m^{-1} and thus much higher than before. Such
a performance is attributed to the presence of copper vapor, which increases
the electron concentration in the discharge, and to the design of the cathode.
At higher than optimum partial neon pressures the electron concentration in-
creases but the electron temperature drops. At higher than optimum paritial
helium pressures the electron temperature rises but the electron concentration
decreases. Further studies concerning the effect of copper vapor, also the
effect of oxygen and hydrogen admixtures on emission cutoff, are contemplated.
The authors thank V.V. Lebedeva, A.I. Odintsov and D. Zhechev for the helpful
suggestions. Figures 3; references 17: 12 Russian, 1 Polish, 4 Western.

[282-2415]

INFLUENCE THAT DISPERSION OF THE ACTIVE MEDIUM HAS ON THE INTERACTION OF GAS LASER MODES WITH A LONGITUDINAL MAGNETIC FIELD

DUBOVETS, V.G.

[Abstract] Conditions under which dispersion of the active medium in a gas laser in a longitudinal magnetic field can influence the emission intensity are established theoretically, by analysis of possible changes in the modal content due to changes in the polarization. The emission is described by cyclic matrices for a Faraday rotator and a linear polarizer, as well as for the active medium, all between two mirrors forming the resonator cavity. From the resulting eigenvalue problem, assuming a Maxwell distribution with respect to velocity, the author calculates the components of the susceptibility tensor and then the emission intensities at each frequency. Depending on the mode separation, especially at small but not at large separations, dispersion of the active medium can contribute to mode selection and extend the stability of emission modes, including the two-frequency mode, over a wide range of magnetic field intensities in both directions. The author thanks P.A. Apanasevich and A.P. Voytovich for the discussion of these results. Figures 2; references: 4 Russian.

[282-2415]

EFFECT OF IMPURITIES ON THE RADIATION-OPTICAL PROCESSES IN A RUBY

BESSONOVA, T.S., STANISLAVSKIY, M.P., KHAIMOV-MAL'KOV, V.YA. and SOBKO, A.I.

[Abstract] Induced optical absorption, thermoluminescence and radioluminescence
of ruby crystals were examined, for the purpose of determining the effect of
random impurities of Mg, Ti, V, Mn, Co, Ni introduced during heat treatment
and thus present in addition to intentionally added Cr. Ruby crystals for this
experiment, grown by the Verneuill method, were heat treated in vacuum at
2200 K for 48 h or in oxygen at 1770 K for 150 h. The chromium content was
maintained at approximately 0.02% in all specimens, while other impurities
were added in quantities from a few thousandths of a percent to 2%. Specimens
for absorption and thermoluminescence analysis were exposed to a 10^6 R dose
of gamma radiation from a Co^{60} source till saturation of color centers.
Specimens for radioluminescence analysis were excited with electrons from
a Tl^{204} source at a dose rate of 3 R/s. Here the respective intensity character-
istics are compared with those of pure ruby crystals and the presence of these
impurities, depending on their valence, found to influence the kinetics of the
said radiation processes. The results, namely the differences, are attributed
to the effect of impurities on the mechanisms of charge compensation, electron
entrapment, electron-ion pair entrapment and recombination. Figures 2;
referneces 22: 15 Russian, 2 Czechoslovak, 5 Western.

[282-2415]

STRUCTURE OF AN INFRASONIC FIELD IN A SHALLOW SEA

AGEYEVA, N. S. and KRUPIN, V. D., Institute of Acoustics, USSR Academy of
Sciences

[Abstract] A study is presented of the sonic field of a point harmonic
radiator in a shallow stratified sea. The studies were performed by machine
experimentation in the infralow and low frequency bands. The bottom was
modeled as a half space filled with a homogeneous absorbing fluid or a solid
medium. The sonic field was represented as the sum of normal waves, the
characteristics of which are expressed through the eigenvalues and eigenfunc-
tions of the boundary-value problem for a second order differential equation
with variable coefficients dependent on the $c(z)$ profile, and was defined by
numerical procedures on a computer. The method of machine experimentation
allows many regularities to be studied in sonic fields, particularly the in-
dividual influence of various factors, determination of which may be quite
impossible in field experiments. Figures 6, References 4 Russian.

[260-6508]

STATISTICAL CHARACTERISTICS OF PULSATIONS OF PRESSURE IN THE ZONE OF FLOW
SEPARATION ON A PLATE BEYOND AN INTERCEPTOR

VLASOV, YE. V., GINEVSKIY, A. S., KARAVOSOV, R. K. and FRANKFURT, M. O.

[Abstract] Previous studies have shown that the increase in pressure pulsations
in the zone of separation on the surface of a flight vehicle reach their
maximum near the point of attachment, then smoothly decrease over a distance
equal to 1-2 times the length of the recirculation zone. This work was per-
formed to accumulate further information on the pressure pulsations in the
stern separation zone behind an interceptor at subsonic velocities. The
correlation characteristics are particularly emphasized. The experiments
were performed in a wind tunnel with an open experimental area 2.2 m in diameter

at a constant velocity of 40 m/s with 0.35% turbulence of the flow. Analysis
of the space-time correlation of pressure pulsations in the low and high
frequency areas shows that in the first case, there is convection of the pres-
sure pulsations downstream at a velocity less than the velocity of the inci-
dent flow and equal to the velocity of movement of the sources in the mixing
layer; in the second case, the velocity of convection of high-frequency
pulsations is significantly greater than the incident flow velocity and ap-
pears to be equal to the speed of sound. Figures 6, References 10: 5
Russian, 5 Western.

[260-6508]

GENERATION OF SOUND BY LASER RADIATION IN A LIQUID HALF SPACE WITH TWO
TYPES OF BOUNDARY IRREGULARITIES

KASOYEV, S. G., LISOVSKAYA, M. G., LYAMSHEV, L. M. and SEDOV, L. V.,
Institute of Acoustics, USSR Academy of Sciences

[Abstract] A study is made of the generation of sound in a liquid half space
with an irregular boundary upon absorption of optical radiation with modulated
intensity. It is assumed that the free, irregular surface of the half space
is struck by a laser beam, and the expression for the sonic field generated
in the half space is produced by a method based on the principle of reciprocity
in acoustics. The sonic field in the distant zone is studied. The influence
of irregularities of the liquid medium on the mean sonic field is determined
independently for large and small irregularities, which are assumed to be
superimposed. Analysis of the expressions describing the mean intensity of
the sonic field in a half space with two types of boundary irregularities
indicates that if the radius of the light spot on the surface of the liquid
is much smaller than the correlation radius of large boundary irregularities,
the influence of these irregularities can be ignored. If the radius of the
light spot is equal to or larger than the radius of correlation of large
irregularities, the influence of small irregularities will be relatively
slight only for directions of observation near the vertical. Beginning at a
certain angle of observation, the mean intensity of the sonic field is
practically fully determined by the small irregularities. Figure 1,
References 5 Russian.

[260-6508]

DIFFRACTION OF PLANE SONIC WAVES ON A HOLLOW ELASTIC CYLINDER PLACED IN
AN OPEN CIRCULAR LAYER OF FINITE THICKNESS

LEYKO, A. G.

[Abstract] A study is made of the problem of diffraction of plane sonic waves
on an infinite elastic cylinder located in an open circular layer of finite
thickness. The mathematical behavior of the system, consisting of the elastic
cylinder in a layer of liquid, is described by a system of differential
equations consisting of the scalar Helmholz equation and the differential
equations of motion of the thin shell. Numerical calculations are performed
for a specific hollow cylinder made of a piezoceramic material. The angular
distribution of the standardized field scattering amplitude is illustrated.

[260-6508]

FREE ROTATION OF A SOLID BODY WITH A CAVITY CONTAINING VISCOUS FLUIDS

NGO ZUI KAN, Voronezh Institute of Forestry Engineering

[Abstract] A solid body with a cavity is considered, this cavity containing
m+1 different immiscible viscous incompressible fluids and the whole system
rotating about a stationary point 0. The problem of small perturbations is
formulated in two systems of rectangular coordinates, one fixed with the
origin at 0 and one moving with the body. The analysis is based on linearized
Navier-Stokes equations for each fluid and appropriate boundary conditions at
the interfaces between fluids. This hydrodynamic problem is mathematically
a Cauchy problem which can be solved by reducing it first to two operator
equations and then to a system of Volterra equations with a weak sinfularity.
It can also be solved by an asymptotic method, in the case of high viscosity,
with the use of a small parameter (reciprocal of viscosity) which reduces it
to a single ordinary differential equation in a Hilbert space. It is solved
here to the third approximation for the vector of relative velocities of fluid

particles. The result can be used for obtaining an ordinary differential
equation with a small parameter for the vector of angular velocity of the body,
also solvable by an asymptotic method. The author thanks professor S.G. Kreyn
for the valuable suggestions and the continuous interest in this study. The
article was presented by academician A.Yu. Ishlinskiy 16 Oct 78. References:
8 Russian.

[258-2415]

VORTEX STRUCTURES OF THIN WINGS IN FLOWS WITH SEPARATION

KARASK, A. A. and NISHT. M. I.

[Abstract] This work presents an experimental study of the specifics of
formation of the vortex structures around thin, broad-span wings, and determines
the angles of attack and slip at which separation of the vortex shrouds from
the plane of the trailing edge of the wing occurs. The studies were performed
in a subsonic wind tunnel at Reynolds numbers of 1 to 10^6. The flow was
visualized by the vapor shield and shadow optical methods. Flow photographs
are presented. Figures 3, References 4 Russian.

[274-6508]

DEPENDENCE OF THE KINETIC ENERGY OF TURBULENCE ON THE PARAMETERS OF FLOW
IN WATERWAYS

NABOTOV, D.N. and GOL'DINA, V.D., Institute of Mathematics and Computation
Center, Academy of Sciences of the Tadzhik SSR

[Abstract] The dependence of the kinetic energy and of the turbulence inten-
sity (square root of energy divided by velocity) on the parameters of flow in
waterways is determined from a model equation for energy fluctuations, this
equation being derived from three fundamental equations for a uniform flow of
an incompressible fluid through an open channel with "equivalent" boundary
conditions representing the effect of roughness of the bottom surface. Eddy
viscosity as well as energy dissipation and diffusion are described by conven-
tional approximate relations, the turbulence scale is expressed as any conven-
tional function of the transverse coordinate. A solution of the model equation
for the boundary layer reveals that, in the second approximation, with a low
eddy viscosity both the turbulence energy and the turbulence intensity decrease
with a higher Reynolds number and increase with a higher Froude number, while
with a high eddy viscosity the turbulence intensity is inversely proportional
to the Froude number. Within the outer region of the boundary layer, where
generation and dissipation of turbulence energy are negligible in comparison
with diffusion, the turbulence intensity is directly proportional to the
Reynolds number and inversely proportional to the Froude number squared. These
relations do not depend on the manner in which the scale factor is defined.
References 9: 6 Russian, 3 Western.

[256-2415]

HEAT TRANSFER BY NATURAL CONVECTION BETWEEN CONCENTRIC ISOTHERMAL SPHERES

SOLOV'YEV, S. V. and LYALIKOV, A.S., Tomsk Polytechnic Institute

[Abstract] The problem of natural convection in layers between two concentric spheres has been solved numerically for liquids and gases, covering an extended range of both the Prandtl number (0.2-5) and the Rayleigh number (8.10^3-8.10^7), with the ratio of inside diameter (d) to outside diameter (D) varied from 0.5 to 0.83 and the temperatures of both spherical surface maintained constant. The solution is based on the Navier-Stokes equations of steady flow and heat transfer from the hot inner sphere, the continuity equation and the energy equation in the Boussinesq approximation. The problem reduces to three equations which in dimensionless form combine into one equation for the vortex intensity, the flow function and the energy function. The solution yields the distribution of stream lines, tangential velocity, temperature and local Nusselt number. An evaluation of data for 22 different input conditions, by application of the Simpson rule and the method of least squares, results in the similitude equation $N_{Nu,d} = 0.450 \, (d/D)^{0.031} N_{Ra}^{0.226}$ accurately describing natural convection in the given system. Figures 4; tables 2; referneces 7: 4 Russian, 3 Western.

[281-2415]

LAMINAR BOUNDARY LAYER AT THE WALLS OF AN AXISYMMETRIC CHANNEL WITH TWISTING OF THE MAIN STREAM

BOGDANOVA, V.V., Leningrad Polytechnic Institute imeni M.I. Kalinin

[Abstract] Laminar flow of an incompressible viscous fluid in the boundary layer is considered in an axisymmetric channel with a curcilinear generatrix. The equations of such a boundary layer with the appropriate boundary conditions are solved with the aid of a new variable $\eta = y \sqrt{U/2\nu x}$ (involving the known

longitudinal velocity $U(x)$ in the main stream, the kinematic viscosity ν , coordinate x along the channel generatrix and coordinate y normal to the channel wall) and the known radius function $r(x)$ characterizing the channel shape. Solution of these equations by successive approximations and subsequent numerical integration yields, in a typical case of a converging channel, the longitudinal distributions of the friction coefficient and of the boundary layer thickness, both referred to the square root of the Reynolds number. Figures 4; references 4: 2 Russian, 2 Western.

[281-2415]

USSR   UDC 532.517.4:533.951.7

THEORETICAL DETERMINATION OF THE CORE IN A TURBULENT NONISOTHERMAL JET OF VARIOUS GASES DISCHARGING INTO A FLOODED SPACE

Minsk INZHENERNO-FIZICHESKIY ZHURNAL in Russian Vol 36, No 5, May 79 pp 885-890 manuscript received 13 Jun 78

GORSHKOV, G. F. and TERPIGOR'YEV, V.S., Siberian Scientific Research Institute of Power Engineering, Novosibirsk

[Abstract] Isobaric turbulent jet flow of a compressible viscous gas is co-sidered when such a gas discharges from a nozzle at a stagnation temperature of 10^4 K into a space already flooded with some other gas. The analysis is based on integration of the differential equations of continuity, momentum, energy, and mass transfer. The effective dynamic, thermal and diffusion thicknesses of boundary layers are defined from the conditions of zero fluxes of excess heat, mass and momentum at the boundary. The results of numerical solution on a BESM-4 high-speed computer according to a program written in ALGOL-60 for argon, helium, and nitrogen jets flowing into an air-flooded space are found to agree closely with experimental data on the longitudinal distributions of jet parameters and yield the length of the jet core, also the effects of compressibility and superheat on its expansion. Figures 4-tables 1; references 9: 8 Russian, 1 Western.

[281-2415]

EFFECT OF INITIAL TURBULENCE ON THE EFFICIENCY OF COOLING A PERMEABLE WALL

GLAZKOV, V.V., GUSEVA, M.D., ZHESTKOV, B.A. and LUKASH, V.P.

[Abstract] Comparative data have been obtained on the coefficients of heat transfer during cooling of various plates by a turbulent air stream. In the model experiment an air stream was passed through a clearance, without or with a variable turbulizing mesh, over hot smooth and perforated plates made of steel and Textolite. The profiles of excess temperature and equilibrium temperature along the plate wall, with a small or with a large velocity reduction, indicate that increases of initial turbulence intensity generally cause increase in the relative heat transfer coefficient on both smooth and perforated plates, but significant ones only at the front edge and increasingly negligible ones farther down along the wall. In the case of jet cooling, initial turbulence influences the heat transfer near the beginning of the boundary layer as well as the length of the flow development zone. Figures 4; tables 2; references 11: 5 Russian, 6 Western.

[280-2415]

GENERALIZED DIFFUSION THEORY OF BINARY HOMOGENEOUS MIXTURES.   FLOW OF A MIXTURE
IN AN INFINITELY LONG ROTATING CYLINDER

NGUEN VAN DIEP, Hanoi (Socialist Republic of Vietnam)

[Abstract] Equations of the author's earlier generalized diffusion theory
describing the flow of a multicomponent mixture with each component at a
different temperature are here derived for the case of a binary mixture with
both components at the same temperature. In addition to the temperature and
the diffusion currents of both components, there also appears in these
equations a characteristic velocity. This can be the mean-mass velocity, the
mean-volume velocity, the mean-molar velocity, or the velocity of either
component, and the equations will assume correspondingly different forms.
In the simple case of a binary mixture of fluids in an infinitely long rotating
cylinder, for example, it is most convenient to use the mean-volume velocity.
The differential equations of flow in such a cylinder are solved here according-
ly, assuming constant partial volumes of both components. References 4:
2 Russian, 2 Western.

[280-2415]

HEAT EXCHANGE IN TURBULENT GAS FLOWS WITH HIGH FREQUENCY PRESSURE
FLUCTUATIONS

GALITSEYSKIY, B. M.

[Abstract] Studies were performed to determine the conditions under which the
maximum intensity is achieved in the process of heat exchange with resonant
oscillations of a turbulent gas flow in channels. A mathematical model of
the process is constructed. The distribution of the spectrum o-f regular
oscillations with radius of the channel is shown, as well as the time-averaged
relative mass velocities in a channel. The spectrum of regular oscillations

of velocity of the gas flow is found to vary near the wall of the channel: the amplitude of oscillations at the main harmonic decreases, while the amplitude of oscillations at higher harmonics increases. In a turbulent flow, oscillational energy is pumped from the main harmonic to the higher harmonics, leading to an increase in the intensity of turbulent pulsation near the surface and, consequently, intensification of heat exchange under the influence of oscillations. Figures 6, References 5 Russian.

[264-6508]

SEMIEMPIRICAL METHOD OF DETERMINING LOCAL HEAT TRANSFER COEFFICIENTS UPON FLOW AROUND A SPHERE

KUDRYASHEV, L. I. and KLYUYEV, N. I.

[Abstract] The local heat transfer coefficients are determined from the distribution of temperatures in the vicinity of points on the surface of the body being studied, an extension of an earlier method to include the case of unsteady heat conductivity, considering the variation of thermophysical characteristics of the material with temperature and radiation characteristic for the beginning of the development of the process of heat exchange. The heat transfer coefficient is determined as a function of polar angle and time. References 2.

[264-6508]

EFFECT OF THE INITIAL BOUNDARY LAYER ON LOSSES IN TURBOMACHINE CASCADES

SHERSTYUK, A.N., doctor of technical sciences, professor, Chair of Hydraulics, Pumps and Compressors, "Order of Labor's Red Banner" Moscow Institute of Chemical Machinery, and SMIRNOV, G.M., engineer, Saratov Polytechnic Institute

[Abstract] An experimental study was made at the Moscow Power Engineering Institute, to determine the dependence of losses in a turbomachine cascade with a 90° entrance angle on the length of the initial segment of the boundary layer. The results are shown to be theoretically predictable on the basis of a semiempirical relation between the end-loss factor and the profile-loss factor. Calculations involve the momentum thickness of the boundary layer at the hub, dependent on the Reynolds number, and parameters of the blading geometry. This has been verified by numerical data for laminar flow, values of the profile-loss coefficient having been determined experimentally. Figures 4; tables 1; references: 1 Russian.

[268-2415]

MOVEMENT OF THE JOURNAL OF A SPHERICAL GAS BEARING UNDER THE EFFECT OF IMBALANCE AT LOW COMPRESSION RATIOS

LYUSIN, V. M., Leningrad

[Abstract] A study is made of the process of complex movement of the hournal of a spherical gas bearing under the influence of imbalance. A drawing of the bearing is presented. The journal is caused to "float" in the bearing by feeding gas into the hemispherical cup in which it rests through a system of apertures connected to a supply chamber in which a constant pressure is maintained. The complex movement of the journal is described by a system of equations of motion and the Reynolds equation for determination of the pressure field in the lubricating gap. Graphs are presented of the amplitude of forced

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by feeding gas into the hemispherical cup in which it rests through a system
of apertures connected to a supply chamber in which a constant pressure is
maintained. The complex movement of the journal is described by a system of
equations of motion and the Reynolds equation for determination of the pressure
field in the lubricating gap. Graphs are presented of the amplitude of forced
stable movement of the journal with certain fixed values of the physical and
geometric parameters of the bearing. Conditions are given under which the
amplitude of forced movements will be equal to 0, and under which there will be
no resonance. Figures 2, References 5: 4 Russian, 1 Western.

[265-6508]

EXPERIMENTAL STUDY AND METHOD OF CALCULATION OF CRITICAL THERMAL LOADS
DURING BOILING OF HELIUM IN PIPES

ARKHIPOV, V. V., KVASNYUK, S. V., engineers, DEYEV, V. I. and ANDREYEV, V. K.,
candidates of technical sciences, Moscow Engineering-Physics Institute

[Abstract] An experimental study of the influence of boiling-mode parameters
on the critical heat fluxes during boiling of helium was performed in '
pressure range between 100 and 200 kPa, at mass velocities of 80 to 320
$kg/(m^2.s)$ with vapor contents below the maximum. The test stand used is a
closed helium loop, with the low-temperature portion in a 35-liter cryostat.
Variation of the critical load as a function of vapor content, mass velocity
and pressure is presented in graphic form. An equation is derived for
calculation of the critical load, and compared with the results of equations
developed by other authors. It is found that the critical thermal loads

decrease with increasing pressure and vapor content, while mass velocity may
have either a positive or a negative influence on critical thermal load.
The method suggested for calculation of critical thermal loads satisfactorily
describes the experimental results. Additional studies are required to
determine the influence of channel diameter on critical thermal loads. Figures
4, References 7: 6 Russian, 1 Western.

[273-6508]

COMPARISON OF TRIANGULAR AND SQUARE ARRAYS IN A TUBE BUNDLE WITH LONGITUDINAL
FLOW AROUND THE TUBES

KALAFATI, D. C., doctor of technical sciences and POPALOV, V. V., engineer,
Moscow Institute of Power Engineering

[Abstract] A study is made of longitudinal flow of a single-phase coolant
around a smooth bundle of tubes at a predetermined heat flux and temperature
of the flow at the inlet and outlet of the heat exchanger. It is found that
when the heating surface and heat flux are constant, triangular configuration
of the tubes in the bundle is always more effective than square configuration,
both in terms of total power expended in circulation of the flows inside and
outside the tubes, and in terms of minimizing dimensions. Figures 3,
References 3: 2 Russian, 1 Western.

[273-6508]

SYNTHESIS OF AN OPTIMAL FAST-RESPONSE CONTROL FOR AN OSCILLATORY SYSTEM

MAMALYGA, V.M., Moscow

[Abstract] A swinging pendulum is considered whose pivot point can move horizontally at some velocity $v(t)$ such that $-V_1 \leqslant v(t) \leqslant V_2$ ($V_1 \geqslant 0$, $V_2 > 0$). The problem is to determine the function $v(t)$, under the given constraints, which will transfer the pendulum from an initial state $\Theta(0) = \Theta_0$, $\frac{d\Theta}{dt}(0) = \Omega_0$, $X(0) = 0$, $\frac{dX}{dt}(0) = 0$ to a final state $\Theta(T) = 0$, $\frac{d\Theta}{dt}(T) = 0$, $X(T) = A$, $\frac{dX}{dt}(T) = 0$ (Θ- denoting the angular displacement from the vertical, X denoting the horizontal linear displacement) in the minimum time T for the given values of constants V_1, V_2, Θ_0, Ω_0, A. This control problem is solved in dimensionless variables in the phase plane and the optimum solution is sought according to Pontryagin's maximum principle, considering the various possible constraints. The family of parametric switching surfaces is plotted and the necessary correction for damping of oscillations at the endpoint is calculated. The author thanks F.L. Chernous'ko and B.N. Sokolov for the helpful comments and for the discussion of the results. Figures 7; references 14: 11 Russian, 3 Western.

[278-2415]

UNCOMFORTABLE WALK OF A TWO-LEGGED PACING APPARATUS

BELETSKIY, V.V. and KIRSANOVA, T.S., Moscow

[Abstract] A two-legged walking a-paratus is considered which consists of a
heavy inert torso and two weightless legs, each a 2-link mechanism (femur and
tibia) and both pivoted jointly to the torso. The motion of this apparatus
is described, in an inertial system of coordinates, for "uncomfortable"
conditions where th_ pivot point of the legs does not move in a straight line
at a constant velocity. This motion is further optimized with respect to
minimum expenditure of energy, on the basis of constant step length and step
time and with two free control parameters. Analytical calculations, cor-
related with experimental conditions simulating the walk of a man, reveal that
for every walking mode there is a pair of optimum values of those two para-
meters which minimizes the work function. Numerical results indicate that with
the center of mass of the torso in a "lower" position it is possible to expend,
over a wide range of velocities, approximately four times less energy than in
a "comfortable" walk. Figures 6; tables 1; references: 6 Russian.

[278-2415]

A PLANE CRACK OF ARBITRARY SHAPE IN AN ELASTIC MEDIUM

GOL'DSHTEYN, R.V., Moscow

[Abstract] A crack of arbitrary shape in a plane (not necessarily simply-
connected) domain is considered at the interface of two half-spaces with
different elastic characteristics. The problem reduces to a system of three
integrodifferential equations with respect to displacement jumps, based on
a force analysis and on a Fourier transformation of the stress-displacement
function at the interface. In the special cases of one homogeneous medium
or of an incompressible material and a perfectly rigid one, moreover, these
equations separate into one for the jump of the normal displacement component
and two for the jumps of the tangential displacement components. Lower and
upper estimates of the crack volume are established, from local to integral
level, which determine the deformation mode as well as the conditions of
fracture. The essentially approximate solution of the problem is generalized
by application of the variational-difference method. This method has also
been extended to two coplanar cracks. The stress intensity factors have been
computed, accordingly, for two identical elliptic cracks at various distances
apart and with their major axes collinear, parallel, or perpendicular. The
author thanks M.L. Kholmyanskiy for the helpful comments on the theoretical
part of this study and V.F. Lantsberg for helping with the computations.
Figures 1; references 21: 12 Russian, 9 Western.

FLEXURE OF A MULTILAYER STACKED BEAM

RADIOLIO, M.V., Odessa

[Abstract] A composite beam is considered which consists of n+ 1 stiff layers with compliant Winkler interlayers. Each layer has a different but uniform stiffness and each interlayer has a different but uniform compliance. The bottom layer of this stack is hinge-supported at both ends and all layers are extended to the span of the longest one. The flexure problem reduces to a system of differential equations for the deflection curves and then to a system of integral equations with the Green matrix of the corresponding scalar boundary-value problem and with a normal Jacobian. The problem can be solved exactly, through a linear homogeneous system of equations in Kronecker deltas and then an algebraic equation whose roots are the characteristic values of that Jacobian. The results serve as a basis for problems which cannot be solved exactly, such as beam stacks of variable-stiffness layers of different lengths and on an elastic base. Practical applications are found in ship-building and such problems as docking a ship, also in the design of leaf springs or film lubrication systems. The author thanks G.Ya. Popov for the discussion. Figures 1; tables 1; references 10: 7 Russian, 3 Western.

[278-2415]

NONLINEAR VIBRATIONS OF ELLIPTIC-CYLINDRICAL SHELLS

KOZAROV, M. and MLADENOV, K., Sofia (Bulgaria)

[Abstract] Nonlinear vibrations of a t-in elastic cylindrical shell with an elliptic cross section are analyzed by solving the differential equation of motion according to the Bubnov-Galerkin method. The solution is sought in terms of sine.cosine products and obtained in terms of Jacobian elliptic cosines, which can be evaluated approximately by expansion into Fourier series. A numerical analysis for a wide range of parameter values indicates a close agreement between exact and approximate solutions. Figures 4; references 7: 2 Russian, 2 Bulgarian, 3 Western.

[278-2415]

USSR   UDC 539.3:534.1

ACTION OF A MOVING LOAD ON A CYLINDRICAL SHELL IN AN ELASTIC MEDIUM

YAKUPOV, R.G., Ufa

[Abstract] Under consideration is a dynamic problem of a cylindrical shell under a moving load. Here the shell is infinitely long and thin-walled, rigidly coupled to the surrounding elastic medium and subjected to a wave of radial internal pressure which retains a constant profile and propagates a constant velocity. The resulting displacements and stresses in the shell are determined from the equation of axisymmetric motion, taking into account rotational inertia and shear deformation. These equations are solved with the aid of Laplace transforms and, after asymptotic approximations, inverse Laplace transforms. Results of analytical and numerical calculations indicate that the radial deflection of such a shell decreases monotonically before the wave front and oscillates decayingly behind the wave front. The results can also be interpreted in terms of influence functions characterizing the effect of the pressure profile in the wave on the deflection profile along the shell surface. Figures 3; references 5: 4 Russian, 1 Western.

[278-2415]

USSR   UDC 539.3

THEORY OF SHALLOW MULTILAYER SHELLS WITH FINITE DEFLECTION

KULIKOV, G.M., Tambov

[Abstract] The theory of multilayer shells with finite deflection is extended by taking into account transverse shear and thus arriving at a generally twelfth-order system of three differential equations for the force function, the displacement function and the shear function. Here this theory is applied to a shallow shell consisting of s transversely isotropic layers. The stability problem is analyzed in Cartesian coordinates referred to the inside surface in the initial state. Resolvent equations are derived, including those which describe the shearing edge effect, to satisfy given boundary

conditions and to yield all functions characterizing the state of stress and
strain from given forces and moments. The coefficients are determined from an
appropriate system of linear algebraic equations. This method of analysis is
particularly useful where transverse shear can be represented by two functions.
It is also useful for examination of extreme shell parameters and for general
design of multilayer shells. References: 7 Russian.

[278-2415]

DESIGN OF A CIRCULAR CYLINDRICAL SHELL WITH A FREE EDGE

NERUBAYLO, B. V., Candidate of Technical Sciences

[Abstract] A study is made of the task of designing a semi-infinite circular
cylindrical shell with a free edge, exposed to a radial load which is applied
along the contour lines. Simple calculation equations are produced for the
maximum radial displacement and the force factors. A comparison showed that
the radial displacements calculated by equations based on the semi-momentless
theory and those calculated by the full equations of the theory of shells
coincided practically completely. The solution constructed in this article
should have an accuracy equal to that achieved upon loading of an infinitely
long shell, even when the load is applied to the free edge or near it.

[266-6508]

A MULTICHANNEL GENERATOR OF PSEUDORANDOM PERTURBATIONS FOR SIMULATING THE MOTION
OF A VEHICLE

ZILITINKEVICH, I.S., KUZNETSOV, V.G. and LOSEV, S.A., Chair of Automatic
Control Systems, Leningrad Institute of Mechanics

[Abstract] Simulating the motion of a vehicle requires a transformation of
coordinates of the road surface profile to displacements of the wheel hubs.
With the statistical characteristics of the road surface profile approximated
by a trigonometric series, the realization of the random process which describes
this profile can, by means of appropriate filters, be transformed to correspond-
ing perturbations of the wheel motion without the need for an analytical
description of the latter. Here a generator of pseudorandom harmonic simulating
perturbations is shown which also realizes the time lag between the same per-
turbation at the front wheels and the rear wheels, this time lag being not a
constant quantity but a function of the vehicle speed. The generator includes
a variable-speed electric motor with a gear transmission, a chain of sine-
cosine converters, and an adder. Figures 1; references: 2 Russian.

[276-2415]

FATIGUE OF AN INTERNAL CRACK WITH NEARLY CIRCULAR PLANFORM IN A CIRCULAR
CYLINDER

STADNIK, M.M. and ANDREYKIV, A.YE., Physico-Mechanical Institute, Academy
of Sciences of the Ukrainian SSR, L'voy

[Abstract] Propagation of a flat circular crack in a transverse section of
a long circular cylinder under a cyclic load is analyzed, assuming uniform
axial tension and compression to be alternately applied at infinity. The
problem of cracking kinetics is reduced to a determination of the radius-
vector of the propagating crack contour, its deviation from the radius of
a circle, as a function of the number of load cycles and depending on the
maximum stress intensity factor in the argument of the characteristic fatigue

fracture function. The problem is solved by asymptotic interpolation and expansion in a trigometric series, which yields a system of nonlinear ordinary differential equations. As a specific example the authors consider a plane crack with an initial contour in the shape of a Pascal limacon and a typical numerical example indicating that geometrical instability of the crack contour can develop as the number of load cycles increases. Figures 2; references 12: 10 Russian, 2 Western.

[270-2415]

STATE OF STRESS OF CYLINDRICAL SHELLS IN THE VICINITY OF REINFORCEMENT MEMBERS

KANAUN, S.K., Novosibirsk Institute of Electrical Engineering

EL'KOVSKAYA, T.M., Scientific-Industrial Association, Central Boiler-and-Turbine Institute imeni I.I. Polzunov, Leningrad

[Abstract] The stress problem in the case of cylindrical shells with reinforcements is treated here according to the most general classical theory, taking into account normal and tangential contact forces and moments as well as the elastic characteristics of reinforcement members. The basic configuration is an elastic cylindrical shell with a reinforcement member welded onto it either around the circumference or along the generatrix, and a concentrated radial force acting on that member. The problem of stress distribution is reduced to a determination of the resolving operator function of displacements, forces and moments, with application of the Kirchhof-Love hypotheses. This resolving function is determined here for thick-walled shells ($r/h = 5$-15) and thin-walled shells ($r/h = 50$-100) freely supported at both ends, i.e., of infinite length. Distributions of axial and hoop stresses and contact pressure around the inside surface and the outside surface of such shells in the section through the center of the reinforcement member have been calculated on an M-222 computer, and the trend of these distributions is found to follow closely the experimentally established one. Figures 4; references 12: 9 Russian, 1 Polish, 2 Western.

[270-2415]

EXPERIMENTAL STUDIES OF LOCAL STABILITY OF SPHERICAL SHELLS WITH REINFORCED HOLES

GUDRAMOVICH, V.S. and DISKOVSKIY, I.A., Dnepropetrovsk

[Abstract] Various machine components in the form of cylindrical and conical shells under local loads can be transversely stiffened with diaphragms in the form of spherical segments. Holes in such diaphragms reduce the weight without significantly lowering the load capacity, but reinforcement of these holes with bushings can actually increase the load capacity of a segment by raising the critical stress level at which local loss of stability may occur. Here an experimental study was made to determine the effectiveness of such reinforcement in spherical segments made of Amg6 aluminum alloy and of Kh18N9 alloy steel stampings with center holes. At the base these segments were reinforced with rings to simulate rigid clamping. The bushings in the center hole were either centered or off-centered relative to the edge of the hole. The test data for segments of both materials indicate that, as the ratio of hole diameter to base diameter increases, the critical local pressure referred to that for a solid segment increases slowly to a maximum and then decreases sharply when the hole is reinforced and decreases monotonically when the hole is not reinforced. Offset reinforcement can lower the critical pressure level and cause deformation under load to begin already under a fraction of the critical pressure. The authors thank N.M. Stepanov and Ye.I. Dubinin for helping with the formulation of the problem and for discussing the results. Figures 2; tables 2; references: 4 Russian.

[270-2415]

STATE OF STRESS AND STRAIN OF PISTON RINGS WITH WEAR-RESISTANT COATINGS

KULIK, A.YA and SHAPIRO, M.I., Central Scientific Research Institute of Diesel Engines

[Abstract] The wear resistance of piston rings for internal combusion engines is increased by coating of the active surface. Subsequent ling of the rings after the plasma-arc or gas-flame coating process produces idual stresses which distort the elastic curve and the distribution of radial pressure, thus reducing the efficiency and the safety margin. Here these residual stresses are calculated from the ordinary differential equation of displacement due to a bending moment, for a ring which in the free state is assumed to be a circular cylinder. The solution to this equation indicates what the ring shape prior to coating should be so that the distribution of radial pressure in the free state after coating will be uniform. Figures 4; references 4: 3 Russian, 1 Western.

[270-2415]

STUDY OF THE STRESS-STRAIN STATE OF A RIBBED SHELL OF REVOLUTION UNDER THE INFLUENCE OF EXTERNAL PRESSURE

ISAKHANOV, G. V., GULYAR, A. I., KAZAK, A. L., RODICHEV, YU. M. and SAKHAROV, A. S., Kiev Institute of Construction Engineering, Institute of Strength Problems, Ukranian Academy of Sciences

[Abstract] It was shown earlier that cylindrical shells of materials such as glass and ceramics, reinforced with circular stiffening ribs, have significant load-bearing capacity under the influence of external hydrostatic pressure. This type of material has ideal elasticity throughout the entire range of deformations up to failure. This work presents the results of experimental and calculation estimates of the stress-strain state of a cylindrical glass-ceramic shell reinforced with internal stiffening ribs under the influence

of external hydrostatic pressure. This type of material has ideal elasticity throughout the entire range of deformations up to failure. This work presents the results of experimental and calculation estimates of the stress-strain state of a cylindrical glass-ceramic shell reinforced with internal stiffening ribs under the influence of external hydrostatic pressure. The results confirm the possibility and practical expediency of using the method of optimal planning of ribbed cross sections of brittle materials based on the solutions of the theory of thin shells for selection of structural parameters of sections being designed. Figures 2, References 9: 8 Russian, 1 Western.

[271-6508]

THE ELASTIC EQUILIBRIUM OF CYLINDRICAL HETEROGENEITIES THROUGH THE THICKNESS OF A TUBE UNDER THE INFLUENCE OF SURFACE LOADS AND DISPLACEMENTS

GORBACHEV, V. I., Moscow

[Abstract] Thick-walled multilayer cylinders are widely used as structural elements. In this work, the method of the small geometric parameter (ratio of period of structure to thickness of pipe) is used to reduce the problem of elastic equilibrium of a long, periodically heterogeneous (in thickness) tube exposed to surface and body forces, to a recurrent sequence of similar problems for a tube of homogeneous thickness. The effective moduli of elasticity are naturally determined. The convergence of the method is demonstrated on the example of the problem of an infinite multilayer tube exposed to pressure. A figure illustrates the distribution of radial and circular stresses, related to the shear modulus of the inner layer, in an infinite two-layer tube with dimensionless internal radius equal to one and external radius equal to two, when exposed to internal pressure. Figure 1, References 6 Russian.

[271-6508]

FREE OSCILLATIONS OF A RIBBED CYLINDRICAL SHELL WITH A MASS ON SPRINGS

AMIRO, I. YA. and PALAMARCHUK, V. G., Kiev

[Abstract] A study is made of a circular, closed cylindrical shell of constant thickness, regularly reinforced and carrying an internal mass attached to diametrically opposite points by two springs of identical rigidity. The shell is assumed to be ideally elastic and thin. The ribs are taken as one-dimensional elements. The results of the analysis indicate that as the natural frequency of oscillations of the mass increases, the normal modes of the system increase. Figures 2, References 3 Russian.

[271-6508]

THERMOELASTIC-PLASTIC DEFORMATION OF CORRUGATED SHELLS OF REVOLUTION AT FINITE DISPLACEMENTS

PETUSHKOV, V. A. and SHNEYDEROVICH, R. M. (Deceased), Institute of Machine Science

[Abstract] A method is suggested for numerical study of the nonlinear behavior of corrugated shells of revolution, which takes into account the large geo-metric variability of such shell structures as bellows, leading to geometric nonlinearities, as well as nonlinear behavior of the material as a function of the history of loading, the time and the temperature. The nonlinear behavior of a shell is described by Reissner's equation with some additional terms in the right part modeling the effects of plasticity, creep and the influence of loading rate. The distribution of zones of plasticity in the most heavily loaded cross section and the distribution of intensities of stress and strains along the meridian are illustrated. Figures 6, References 11: 8 Russian, 3 Western.

[273-6508]

NUMERICAL DESIGN OF THICK-WALLED CYLINDERS WITH VARIABLE MODULUS TO WITH-
STAND THE EFFECTS OF UNDERWATER WAVES

BABICH, YU. N. and GALIYEV, SH. Y., Institute of Strength Problems, Ukranian
Academy of Sciences

[Abstract] A study is made of a smooth cylinder consisting of two parts made
of different materials, attached at their ends to an absolutely rigid, in-
finitely long screen. A pressure wave in the liquid surrounding the cylinder
moves perpendicular to the axis of symmetry of the cylinder and strikes its
surface. The first moments of loading after the impact are investigated
when the interaction of the structure with the liquid can be studied using the
hypothesis of plane reflection. A difference system is developed which allows
numerical study of the three-dimensional stress-strain state of cylinders
with different moduli, assuring stability and high accuracy of calculations.
Figures 5, References 12: 10 Russian, 2 Western.

[273-6508]

CALCULATION OF THE PARAMETERS OF AN EQUIVALENT CIRCUIT FOR A RADIALLY
POLARIZED PIEZOCERAMIC SPHERE

BRAILOV, E. S., VASSERGISER, M. YE. and DOROSH, A. G., All-Union Scientific
Research Institute of Metrology, Measurement and Control Systems

[Abstract] A study is made of the equivalent circuit for a radially
polarized piezoceramic sphere with arbitrary wall thickness under hydro-
static loading, and the parameters of the sphere are calculated. The os-
cillations are assumed to be harmonic and radially symmetrical. The most
important particular case, in which a medium with low wave impedance, such
as air, is located inside the sphere, is further stud' a   The equivalent
circuits produced are used to calculate a number of c ar cteristics of
spherical piezoceramic transducers, such as their ser if vity and impedance.
Figures 4, References 17 Russian.

[260-6508]

A STUDY OF UNDERWATER ELECTRIC EXPLOSION OF HELICAL WIRES

ISHENKO, ZH. N. and GULYAEVA, L. YU., Nikolayev

[Abstract] A study was made of the influence of the helical shape of a wife
on the characteristics of its electrical explosion under water. Aluminum
wires 0.8 mm in diameter and 80-180 mm in length were exploded in cylindrical
cartridges. The inside diameter of the helices varied from 3 to 12 mm, the
spacing between turns--from 4.5 to 14 mm. Voltage and current oscillograms
are presented for the explosion of both helical and straight wires. Decreas-
ing the diameter and spacing between turns of a helical wire leads to a
decrease in the time to explosion of the wire, current, and time over which
energy is liberated, and an increase in the overvoltage peak, impedance of the
discharge channel, and energy liberated during the first half period of
oscillation of the current. The change in the characteristic of the explosion
of a helical wire in comparison to a straight wire indicates the important
role of magnetic forces in the process of electric explosion of wires. Figures
5, References 15: 14 Russian, 1 Western.

[272-6508]

THE INFLUENCE OF BOMBARDMENT WITH FAST ELECTRONS ON THE STRUCTURE OF POLY-ETHYLENE

BARINOV, V. YU., L'vov

[Abstract] A study is made of processes which occur in the structure of polyethylene upon bombardment, leading to the great variations in strength as a function of absorbed dose of radiation which have been observed. Type P 10812-020 low-density polyethylene was bombarded on the EIT-1.5 electron accelerator at 1 Mrad/s. Total doses were 5-80 Mrad. Bombardment was followed by thermal stabilization at 130°C for 1 minute, recording of spectra on the UR-20 spectrophotometer, and tensile testing on an MR-500 machine at $1.1 \cdot 10^{-1} s^{-1}$. The changes in the structure were studied by IR spectroscopy, observing the changes in optical density of the 730 and 720 cm^{-1} bands. The comparatively high strength of polyethylene after doses of 10 to 25 Mrad results from the great mechanical stability of the structure, which contains crystallites with crosslinked regions. At higher absorbed doses, a three-dimensional lattice appears, hindering restructuring of the amorphous-crystalline structure during deformation and thus causing strength loss. Figures 2, References 10: 5 Russian, 5 Western.

[272-6508]

THE ROLE OF ELECTRIC INDUCTION EFFECTS OF MOLECULES IN THE MECHANISM OF GENERA-TION OF CHARGED CARRIERS IN AN ORGANIC FLUID

KAZATSKAYA, L. S. and SOLODOVNICHENKO, I. M., Kherson

[Abstract] A study is made of the problem of the role of electric induction effects in the mechanism of generation of charged carriers in organic fluids. The interface between the fluid and a metal is studied, since organic molecules in contact with metal can develop surface complexes with charge transfer. A variation in conductivity of the fluids as a function of the material of the metal electrode with which they are in contact is experimentally confirmed. These experiments use flat disk electrodes 1 cm in diameter, made of gold, platinum, silver, copper, aluminum and titanium, with measurements

performed at a constant voltage of 50 V. The main charge carriers in the
organic fluid are probably negative or positive ion radicals which arise upon
interaction of the molecules with the metal of the electrode. If the con-
centration of charge carriers present in the organic liquid is low, the
significance of injected carriers may become predominant, determining the
type of charge carriers. References 3 Russian.

[272-6508]

MOROZOV, V. I., USATENKO, S. T. and ESALENKO, V. P., Kiev

[Abstract] One important factor preventing broader introduction of electro-
physical effects on treatment of fluids in production processes is the una-
vailability of measurement devices which can provide rapid information con-
cerning the physical and chemical changes occurring in the fluids being treated.
This article suggests that the effectiveness of electrophysical actions on
water be estimated using electronic devices for measurement of magnetic
susceptibility, not requiring the use of large magnets. The device which has
been developed for this purpose uses a semiconductor oscillator circuit with
a common base, assuring high sensitivity and resistance to interference while
maintaining a rather simple circuit. The magnetic susceptibility is determined
from the change in resonant frequency of an oscillating circuit when the
specimen being tested is placed in an inductance coil. Comparison with more
standard methods indicates that the radiofrequency method of measurement of
magnetic susceptibility can be used to monitor electrophysical effects on
liquid systems. Figures 2, References 5: 4 Russian, 1 Western.

[272-6508]

INFLUENCE THAT CONDITIONS OF EQUIVALENCE HAVE ON THE PROCESS OF MELTING OF
ALUMINUM OXIDE

AXIMOV, S. A., GNENENKO, A. G., ZEBNITSKAYA, N. I. and RUMI, R. F., Physico-
technical Institute imeni S. V. Starodubtsev, Academy of Sciences UzSSR

[Abstract] The problem of melting of materials by concentrated radiant heat
is complicated by the high temperatures and temperature gradients, as well
as by moving boundaries. Determination of the temperature field requires
solution of a nonlinear differential equation with nonlinear boundary conditions.
Experimental studies are complicated by the influence of sensors and other
practical problems. Therefore. model methods are used with maximum considera-
tion of experimental data on the boundary of a region. In this paper the authors
attempt to evaluate the influence of equivalence conditions on the process of
melting of aluminum oxide. In the experiments. the material was placed in
a water-cooled crucible made of D-16 with high thermal conductivity. Focused
radiant flux with gaussian distribution in the radial direction was applied
to the specimen by the URAN-1 radiation heating unit. Powder and pressed
specimens were studied. Measurements made during the experiments included
the temperature on the boundary of the investigated region, the mass of molten
material, the parameters of the cavity formed during melting, the cooling
water temperatures at inlet and outlet, and the flowrate of the water. Ex-
pressions for boundary conditions are given. Figures 2, references 5 Russian.

[279-6610]

INVESTIGATION OF THERMOPHYSICAL PROPERTIES OF CRYSTAL HYDRATES AS APPLIED
TO PROBLEMS OF THERMAL ACCUMULATION

YEGOROV, B. N., REVYAKINA, M. P., TROKHININ, N. N., TRUSHEVSKIY, S. N. and
FEDOROVA, T. M., All-Union Scientific Research Institute of Current Sources

[Abstract] The paper gives the results of an investigation of the thermal
conductivity of hydrated crystals $Ca(NO_3)_2 \cdot 4H_2O$, $Ni(NO_3)_2 \cdot 6H_2O$, $Na_3PO_4 \cdot 12H_2O$,
and $Ba(OH)_2 \cdot 8H_2O$, as well as the heat capacity and thermal diffusivity of
$Ni(NO_3)_2 \cdot 6H_2O$. These materials had been preslected as heat accumulators
with respect to such parameters as the heat of phase transition, compati-
bility with structural materials and cost. The experiments were done in a
temperature range covering the solid and molten states of the materials.
Hydrated crystal $Ba(OH)_2 \cdot 8H_2O$ has the highest thermal conductivity in both
the solid and molten state. Figures 2, references 8 Russian.

[279-6610]

TEMPERATURE DEPENDENCE OF THE SPECTRAL CHARACTERISTIC OF THIN-FILM pCdTe-
nCdS PHOTORECEIVERS

RASULOV, D. T., Physicotechnical Institute imeni S. V. Starodubtsev, Academy
of Sciences UzSSR

[Abstract] An investigation is made of the influence of temperature on the
spectral characteristics of thin-film pCdTe-nCdS photosensors, and the factors
are determined that cause their spectral characteristic to change with
temperature. The measurements were made in a vacuum of about 10^{-3} mm Hg
at temperatures from -60 to +120°C. Displacement of the maximum and the
long-wave edge of photosensitivity is attributed to a change in the width
of the forbidden band, the coefficient of light absorption and the diffusion
length of minority carriers in cadmium telluride. A typical feature of the

spectral characteristics of these film photocells is high stability of photo-sensitivity in the shortwave region of the spectrum. Figures 3, references 2 Russian.

[279-6610]

LESTEV, A.M., Chair of Theoretical Mechanics, Leningrad Institute of Aircraft Instrument Design

[Abstract] A gyrotachometer is mounted to a base through a torsion spring and a ball bearing with a smooth sleeve. Its linear vibrations due to radial bearing clearance and then the resulting null-drift errors of such a device are analyzed on the basis of two fundamental equations of motion in the system, considering a nonlinear relation between the bearing reaction force and the radial shaft displacement. Calculations yield generally a family of amplitude-frequency characteristics and specifically, by successive approximations, an engineering formula for the null-drift error. A typical numerical example is shown where the error of an angular-velocity measurement by a gyrotachometer with a 12 μm bearing clearance is at least 7.6 times larger than the angular velocity of the earth. Figures 3; references: 3 Russian.

[276-2415]

USSR   UDC 531.383

DESIGN OF A CENTRIFUGAL-PENDULAR TACHOMETER

IL'CHANINOV, V.P. and TERESHIN, V.G., Chair of Aircraft Instrument Design, Ufa Institute of Aviation imeni S. Ordzhonikidze

[Abstract] Continuous motion of a centrifugal-pendular tachometer along a curvilinear borehole is considered, with not only a spring force but also dry friction acting on the output shaft of such an instrument. The problem of dynamics is reduced to a nonlinear differential equation in the approximation of small harmonic vibrations with a negligible phase shift. As a result, the effect of dry friction on the dead zone of the sensing element is determined and the maximum width of this dead zone is established, on which the minimum measurable angular velocity or sensitivity threshold depends. The ratio of maximum to minimum measurable angular velocity is, in turn, the basic indicator of performance quality and a function of several optimizable design variables. Figures 1; references 4: 3 Russian, 1 Western.

[276-2415]

USSR   UDC 62-23:620.178.5

STROBOSCOPIC METHOD OF CHECKING THE MOTION OF MECHANISMS FOR UNIFORMITY

KULAGIN, V.V. and GELLER, I.M., Chair of Optical Instruments Design and Production, Leningrad Institute of Precision Mechanics and Optics

[Abstract] The fluctuation of the velocity of any kinematic link relative to the average velocity of the folower can serve as a uniformity criterion for checking the motion of mechanisms. An instrument has been built for measuring these relative velocity fluctuations which includes a friction mechanism coupled to two stroboscopes, each containing a flash tube and an optical dial with radial markers as well as a projector objective and a mirror. Images of makrers on the two disks can be superposed on a photosensitive film with a tape transport mechanism. The frequency of flashes is synchronized with the frequency of markers appearing in the fields of vision of the objectives. Relative velocity fluctuations are determined by measuring

differences and using appropriate conversion factors, as in conventional
stroboscopy. This instrument, tested for suitability as an inspection tool,
has been found to be very precise and to yield much information in a compre-
hensive form so that causes of nonuniform motion can be easily diagnosed.
Its drawbacks are, however, the difficult processing of films and the un-
wieldy computations involved. Figures 2; references 7: 6 Russian, 1 Western.

[276-2415]

A LOW TEMPERATURE HYDROSTATIC PRESSURE CHAMBER MADE OF NONMAGNETIC MATERIALS, DEVELOPING PRESSURES UP TO 30 kbar

ITSKEVICH, YE. S., TOLMACHEV, A. N., SHIROKOV, A. M. and GRIDINA, N. M.,
Institute of High Pressure Physics, USSR Academy of Sciences

[Abstract] The chamber described in this article uses the method of complete
surrounding support by external hydrostatic pressure, with the maximum possible
independence of generation of the internal and surrounding supporting pressures.
This is achieved by the use of two fixed pressure chambers surrounding the
specimen. The small inner chamber has an outside diameter of 16.6 mm, an
inside diameter of 4.75 mm. Operation involves setting of moderate pressure
(1-15 kbar) in the small chamber, which is then placed in the large chamber,
which is placed in a press. Operation of the press increases the pressure
in both chambers simultaneously. After the pressure reaches the desired
level, the retaining nuts are tightened and the two chambers removed from the
press, and can be cooled to low temperatures. The maximum pressure achieved
in the inner chamber to date is about 27 kbar, which the authors believe to
be close to the limit for berylium bronze pressure chambers; however, careful
adjustment of the pressure ratio in the two chambers, careful selection and
heat treatment of the bronze used and other general refinements can increase
the pressure by another 5 to 7 kbar. Any further increase must await the
development of new nonmagnetic materials, particularly for the inner chamber.
Figures 4, References 5: 3 Russian, 2 Western.

[277-6508]

USE OF A DIFFRACTION INTERFEROMETER IN BALLISTIC EXPERIMENTS

KOMISSARUK, V. A., MARTYNOV, V. P. and MENDE, N. P., Institute of Physics
and Technology, USSR Academy of Sciences, Leningrad

[Abstract] The authors used the IAB-451 shadow interferometer, with a grating
with 75 lines per millimeter, and a type OGM-20 pulsed laser in ballistic
shock wave experiments. A diagram of the diffraction interferometer is
presented. Two interferograms are shown, plus a graph of the distribution
of density in a shock wave around a sphere, determined by observation of the
interferograms. Figures 4, References 5: 4 Russian, 1 Western.

[277-6508]

AN INSTALLATION FOR MEASUREMENT OF THE SHEAR STRESS IN SOLIDS AT LOW
TEMPERATURES AND AT HIGH PRESSURES

ZHAROV, A. A., MAKAROVA, Z. G., SHAKHOVSKOY, G. P. and ZHULIN, V. M.,
Institute of Organic Chemistry, USSR Academy of Sciences

[Abstract] The installation described allows experiments to be performed
at very high pressures in inert gas atmospheres while maintaining the
temperature accurate to ± 1 K. The body of the thermostating unit consists
of two parts made of copper, each of which has an inset for an anvil made of
VK-6 alloy. The heat from the thermostat is transmitted through a packet of
copper plates to a foam plastic vessel containing liquid nitrogen. Depending
on the number of plates in the packet, the experimental temperature varies
from 220-300 K (one plate) to 120-150 K (three plates). Plastic foam is also
used to surround the entire experimental apparatus in the press for further
heat insulation. The two thermostats are surrounded by a plexiglas collar
into which a dry inert gas is pumped to prevent condensation of moisture onto
the surfaces of the anvils and contact of oxygen with the substance being
studied. Figures 2, References 1 Russian.

[277-6508]

MACHINABILITY OF OPTICAL CERAMICS BY SYNTHETIC DIAMOND TOOLS

ROGOV, V. V. and BURMAN, L. L., Candidates of Technical Sciences, Institute of Superhard Materials

[Abstract] The Institute of Superhard Materials, Ukranian Academy of Sciences, has developed a technological process for full diamond working of parts of KO-1 optical ceramic using synthetic diamond tools. The introduction of new optical ceramics such as KO-2, KO-4, KO-5 and KO-6 has required the study of the machinability of these materials, as a basis for the development of technological processes for manufacture of various optical parts. Cylindrical ceramic specimens 60 mm in length were tested in the operations of coarse and fine grinding and preliminary polishing, using synthetic diamond tools. Scanning electron micrographs are presented of the surfaces of polished specimens of the materials. The results of the studies indicate that the productivity of diamond working of these materials is less than that of silicate glass. An interrelationship is found between productivity and surface roughness, on the one hand, and microhardness of the material, on the other hand, allowing prediction of the machinability of new types of optical ceramics.

[262-6508]

A DEVICE FOR MEASURING THE CANT OF A SHIP

KUZNETSOV, A. D., LEFAND, I. A., PORTNYKH, V. I.

[Abstract] The authors suggest a special device for measuring the angles
of canting of a ship. The device consists of interconnected vessels,
partly filled with a viscous, incompressible fluid and interconnected by a
tube which contains an adjustable needle valve. The top portions of the vessels
are sealed and connected by air lines to a liquid-filled U-tube differential
manometer which can swing as a pendulum from its suspension point at the
top. There are scales on the side and at the bottom of the swinging U-tube,
to measure the static and dynamic cant of the ship, respectively. The addi-
tion of the hydraulic pendulum increases the accuracy and reliability of
measurement of angles of canting as the ship rolls back and forth, by allowing
their average values to be read over a certain period of time, and also makes
reading easier, since the scale on the U-tube manometer is linear. The
measurement range is $\pm45°$, error $\pm0.8°$, sensitivity $\pm0.5°$. Figures 3,
References 3 Russian.

[261-6508]

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